Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it is the only thing that ever has.

— Margaret Mead

This Bokashi Alternative is Rubbish

Bokashi & Pfeiffer Chromatography Simplified

By

Kenneth Avery

Everyone can repurpose milk cartons and other rubbish for fermenting food waste into a soil additive, which is simple and can be done for free. It is Bokashi simplified using the ALT (Avery Low Tech) Method of Fermenting Food Waste and features the Milk Carton Challenge. It also includes a Supplemental Chapter on Pfeiffer Circular Chromatography (PCC), a simple technique for measuring the "life" in your soil or compost.

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Preface

In this book, you will learn a simple way to recycle kitchen food waste into a valuable soil additive and repurpose rubbish like cardboard milk cartons in the process.

Originally, I intended for this book to be a free PDF book. However, the cost of printing it at home for those who prefer “hard copy” exceeded the price of the book when sold without royalties.

My first challenge was how to make the free PDF version available. I am tired of the tracking, deception, ads, and data mining that have consumed the Internet. Even searching for information is no longer based on relevance and is now for hire. It is getting harder, not easier, to find honest information. To solve this problem, I am archiving this book and all the associated files on the Internet Archive.

You should read about the Archive. I encourage you to use and support it. Not only can you view or download the PDF version of this book, it supports several formats and can even “read” it to you. As long as it stays true to its mission, it will be the single download source for this book and the supporting files and videos.

It is easy to remember the URL of the Archive; it is https://archive.org. If you are not following a link to a specific file or location at the Archive, you can just search “Bokashi alternative." To make it easier, first go to the Avery Low Tech web page at Google Sites. There, you will find links to specific files in the Archive.

I will maintain a Google Sites web page as long as it remains ad-free and less invasive than most of the Internet.

https://sites.google.com/view/averylowtech/home

Contacting me is the next challenge. The Archive does not have an option to contact me, and I understand that. A feature of Google Sites is the ability to use Google Forms for a Contact page.

Another challenge is where to offer the print version of this book. While I am not a fan of Amazon, there are just no alternatives for some of their products. Publishers and distributors don't want to deal with non-profit books. Amazon solves this problem with "print-on-demand." They can print a single copy with a cover and binding for a lower price than anyone else. But it is only available on Amazon. I have elected to not get any royalties, so the book is actually about half the cost of printing the PDF on your home color printer. You can find the book by searching for the ISBN: 9798397116886.

It is very easy to make changes to the PDF version, but making changes to the print version is a bit more complicated. I will attempt to keep them synchronized, but there could be minor differences between the PDF and print versions, with the PDF version having the most recent updates.

There are other resources in this book. I have no control over them changing the URL (address) of that resource. Again, I will try to keep them updated, but non-working ones may require some searching on your part.

I have also tried to eliminate grammar and spelling errors, but that is not possible because of the ambiguity of the rules in our language. Focus on the concepts, and kindly look past those I have missed.

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CHAPTER 1: INTRODUCTION

Any intelligent fool can make things bigger and more complex... It takes a touch of genius - and a lot of courage to move in the opposite direction.

E. F. Schumacher

This quote from Schumacher is very appropriate for this book. We need to think smaller. That is what my ALT (Avery Low Tech) methods are all about: smaller, less complex, and more realistic for all of us to consider and hopefully use.

I want this to be a book that gives you something to think about rather than follow verbatim. I don't want this to be a book about all the issues we face. It is a complex problem that is out of control. The best I can do is set an example for others by doing what I can.

We all know that lots of people doing small things can be more powerful than a few people doing big things. One of my favorite quotes is from a great book by David Mitchell and, in my opinion, one of the best movies ever made, *Cloud Atlas*:

"My life amounts to no more than one drop in a limitless ocean. Yet what is any ocean but a multitude of drops?"

Along the way, I have developed several alternatives to high technology for us real people just trying to do the best we can. Three of these are very closely related and still have relevance today.

They are:

- Fermented Food Waste (FFW)
- Compost Tea Brewing
- Pfeiffer Circular Chromatography (PCC)

I did not invent any of these; I just made them easier and more accessible to those who want to be one of those multitudes of drops.

The ALT (Avery Low Tech) Method of Fermented Food Waste (FFW) is the most universal and practical one that could make a difference far more than the others. It is an alternative to Bokashi, which is not well-known or practiced.

The definition of “food waste” is complicated. Some of the waste occurs as we have moved toward large-scale agriculture and distribution. But much of it is generated at the consumer level in our very own kitchens. Encyclopedia.com has a simple definition that applies to us on a small scale:

> *“Food waste is the discarding of potentially usable food. Both edible and inedible foods may be considered garbage and therefore, wasted. Edible foods are considered inedible when their quality deteriorates until they become unhealthy or noxious. Food deterioration occurs from microbial contamination or from rotting as a consequence of overproduction, storage problems, or improper preparation. Food waste also occurs through food use that returns little nutritional value, like over-processing and overconsumption.*
>
> *Edible foods are also wasted when cultural or individual preferences deem them undesirable. For example, some people dislike bread crusts, so they remove them and discard them. Societies with abundant food supplies often consider reusing leftover foods as inconvenient, while less food-rich societies regard food reuse as imperative. Specific parts of animals and plants considered edible in some cultures are considered inedible in others.”*

Food waste can include fruit, vegetables, meat, dairy, grains (bread and bakery items), coffee grounds (in moderation), small bones, eggs (including shells), cooking oils, and generally anything considered edible. Diversity is important for successful food waste fermentation.

Food waste is a tremendous problem because it rises with affluence, yet food insecurity is rising for the less affluent as well. It doesn't make sense. To compound the problem, poor farming practices and climate change are accelerating the waste.

Reducing food waste is something everyone can do regardless of their type of residence and economic status; at least this is true with my ALT method. It is simple and can even be done at little or no cost, except for commitment. Because the focus is on being one of the drops that make up the ocean, it can have a far bigger impact, not only on reducing food waste but also on raising awareness of small changes that we can make in every facet of our daily lives.

FFW is considered a pre-compost. Pre-composting food waste is very efficient, slows greenhouse gas emissions, and sequesters carbon and nitrogen. As a soil additive, it increases microbial activity and gets nutrients to the plants more quickly than composting.

This is not an instructional manual; it is a concept manual to allow you to create your own instructions that fit your unique situation. Hopefully, it will help you understand FFW. When you then share your understanding, we will become the ocean, which is a multitude of drops.

We can no longer rely on the 1% to solve the problem. They are far too busy letting their egos get in the way of common sense and putting profit ahead of everything. We can no longer rely on our broken political and educational systems, where ideology and declining math and science scores prevail. We can no longer rely on technology that solves one problem and creates ten more (we have a very strong track record of unintended consequences).

All of us need to change practically everything we do, but that is not practical or realistic. What we need to do is make lots of small changes collectively. We now try to drive less, buy more selectively, and waste less. The ALT (Avery Low Tech) Method for Fermenting Food Waste (FFW) is one of those small changes we can all make. It can be done in small amounts, either monthly or weekly. It is scalable in both frequency and size. It is far easier to scale the method to the lifestyle than it is to match our lifestyles to the method.

It brings to mind one of the ending scenes in "*Don't Look Up*," a movie I highly recommend, where the main characters are sitting around the table sharing what they have been thankful for in their lives. The character Kate says, "I'm grateful we tried," just before the end of life on Earth happens.

With Bokashi, I don't think that is true; most people are not going to try it. However, with the ALT method, everyone can say, "We tried."

"... the Latin name for man, homo, derived from humus, the stuff of life in the soil."

--- Dr. Daniel Hillel

CHAPTER 2: WHO CAN YOU TRUST?

I have been involved with computers since the introduction of the personal computer in mid-1970. I previously viewed the Internet as potentially one of the most significant advances in human technology in my lifetime. It has now been squandered and misused to the point where I need to advise people to be very careful and almost distrusting of much of what is now found on the Internet.

There is sometimes flat-out misinformation and distortion, especially when there is a profit motive associated with what is promoted. But the biggest culprit is that anybody can put information on the Internet that they have not validated or verified.

Very little research has been done at the residential level on fermenting food waste (FFW) and composting in general. Most of the science about FFW is done at the agricultural and municipal levels. It usually involves a very large scale and high technology or is very specific and not directly applicable to residential applications.

Another problem is scale. It is far easier to scale something up than it is to scale it down. This is why we build models, or prototypes. The methods used in municipal and large-scale fermenting food waste don't easily scale down, so some of the science is not applicable to the residential level.

When you look at books, websites, and videos about Bokashi, you will find most are written by gardeners. Their interest is in gardening. They may use organic fertilizers with great success, but that does not make them chemists. They may use Bokashi with great success, but that does not make them microbiologists.

They learned Bokashi, a specific technique, using specific equipment in a specific way. It gave them great results, so they became "believers." Over time, it has become embellished, and many of the claims just don't add up.

Even though they are great gardeners, you need to do the science to validate their claims, but at an appropriate scale for you. You also need to be aware that the potential profit motive isn't always a product. It can be advertising or data collection.

It would be ideal if the gardeners promoting Bokashi had done the science, but that is not their passion. However, it is mine.

CAN YOU TRUST ME?

Don't trust me; trust yourself. The method I am going to introduce to you for fermenting food waste is simple and practically free, and I am not selling you anything.

I have been working on this and related techniques for years. I have a very diverse education, including graduate classes in science and education. My microbiology experience comes from several years of clinical and industrial microbiology. I also have an almost innate curiosity about how things work, which is part of my DNA. It comes from hanging out in the shop with my grandfather. He was a self-taught inventor and a master of simplicity and low technology.

I encourage you to do the science, albeit simple Citizen Science (CS), that uses sound scientific principles within a context of common sense and logic. Once you see how the "concepts" work, you can adapt them to your specific needs with an understanding of what and why you are doing it. I will encourage you to share this with others so they can benefit from your understanding.

CHAPTER 3: WHY FERMENT FOOD WASTE?

There are many reasons to ferment food waste. Some might do it to help prevent climate change. Some do it to save money. Some do it out of compassion for the planet we call home. Some do it for their physical and mental health. Some do it because their "gut feelings" tell them it is the right thing to do.

Bokashi is not what our ancestors did; it has only been around for approximately 40 years. It involves equipment that is not practical for much of the world. Our ancestors fermented food waste with locally sourced materials and didn't need patented microbes or expensive bins. The real question should be, "Why not ferment food waste?"

SOIL HEALTH AFFECTS HUMAN HEALTH

Since our gut microbes come from what we eat, drink, and breathe, and all of those come from the planet, we are essentially tiny living Earths. Health issues that will affect Earth will show up in life modeled on Earth (us) first, so we are the proverbial "canary in the coal mine." This is because we are tiny compared to the mass of the Earth. By the time we see the Earth's illnesses, it might be too late. So we should be very concerned about the fact that many of our health issues are now associated with our gut microbes. Daily, there are articles from highly recognized journals and medical professionals attributing our gut microbiome to human health, both good and bad, possibly including increases in Alzheimer's, according to a recent publication in *Nature*.

Cammann, D., Lu, Y., Cummings, M.J. *et al. Genetic correlations between Alzheimer's disease and gut microbiome genera*. *Sci Rep* **13**, 5258 (2023)

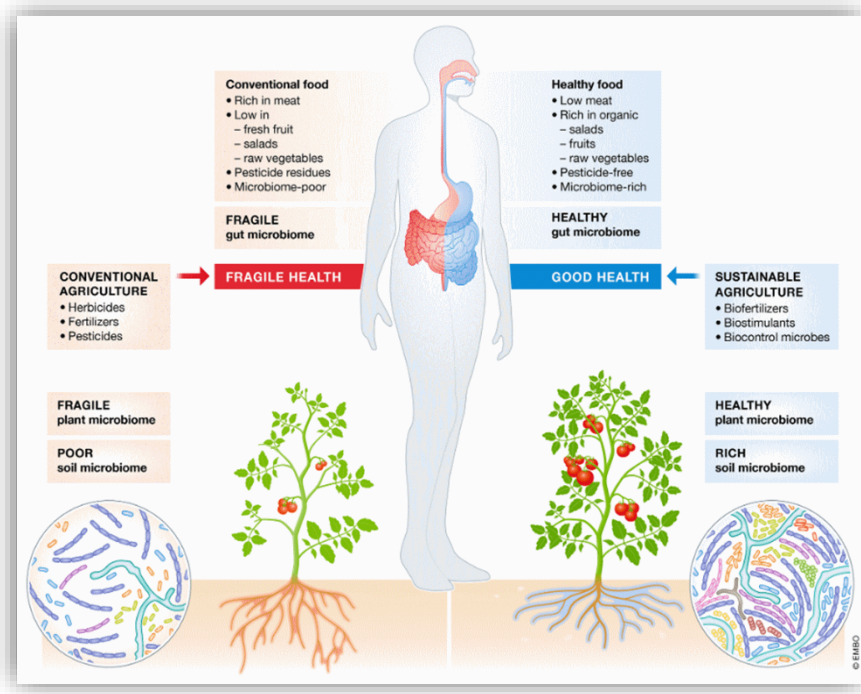

FIGURE 3.1: HEALTHY SOILS FOR HEALTHY PLANTS

This graphic is part of a paper that I highly recommend. The actual paper had much more information and graphics. All three sustainable agriculture techniques mentioned in this graphic are accomplished with fermented food waste.

"Healthy *Soils for Healthy Plants for Healthy Humans: How Beneficial Microbes in the Soil, Food and Gut Are Interconnected and How Agriculture Can Contribute to Human Health"* EMBO Reports, vol. 21, no. 8, Aug. 2020, Heribert Hirt

SOIL HEALTH AFFECTS PLANETARY HEALTH

Science.org discusses how *Modern City Dwellers Have Lost about Half Their Gut Microbes*. The significance of this is that as we find health issues associated with our gut biome, we must realize the same is true of the earth as the soil biome is destroyed. We are the “canary in the coal mine.”

In addition, disposing of organic waste has become a costly and growing environmental problem for urban municipalities. Municipalities simply pass the costs of dealing with these issues on to taxpayers. Much of the food waste in the city I live in ends up being incinerated, which is a huge problem. Food waste contains lots of carbon and nitrogen, which go up the smokestack as carbon dioxide and nitric oxide (250 times more potent than carbon dioxide), both greenhouse gases (GHG). Removing these gases is costly and inefficient. If the residents could reduce the food waste before it reaches the incinerator, then the city would not need to spend taxpayer money to build infrastructure to meet increasingly stringent environmental regulations.

There is only so much carbon and nitrogen on Earth. It is not produced; it is simply recycled. It is very difficult to extract the abundant nitrogen that is in the air we breathe since it is very stable. We use large amounts of energy (much of it from fossil fuels) to "recycle" it into things like fertilizer, which plants do far more efficiently. FFW reduces carbon and nitrogen from becoming GHGs, makes nutrients more accessible to plants than traditional aerobic composting, and decreases methane (25 times more potent than carbon dioxide) production compared to landfill disposal.

PROMOTES CITIZEN SCIENCE

These are "solutions" that take advantage of the situation. One that is widely promoted now is a very expensive bin that costs hundreds of dollars to simply dry and grind food waste as the bin is filled. The resulting material is then boxed and sent to a company that claims to use it for chicken feed. There is a monthly subscription fee for this, in addition to the energy used to dry very wet material. There is a carbon footprint associated with packaging and shipping this material, and the bin has expendable components that are made of non-compostable materials. Consider the total carbon footprint, and you may find it is worse and more expensive than the low-tech ALT method option for the consumer.

In my opinion, this trendy option is an absurd solution. I am also not a big fan of the multitude of yard composting systems that supposedly make it easy to make compost from yard waste. These are also trendy concepts. They rarely produce good compost and end up being plastic planters. Just like the trendy food waste bin, they are marketed to avoid labor and may ultimately be more damaging to the environment than the sweat they claim to save.

Trendy solutions are becoming more dominant as scientific knowledge goes down and targeted mass marketing grows exponentially.

Another thing we are losing is critical thinking, especially in the United States. If you have children or grandchildren, you should be concerned with the dropping scores in science and math for children in this country. Marketing now relies heavily on this. I encourage people to use some citizen science to offset this. Don’t let the generations that will be most impacted by health and environmental issues be misled by trendy, overhyped, poorly researched solutions; teach them to put a little sweat into preventing waste. I learned that from my grandfather.

CHAPTER 4: CONVENTIONAL RESIDENTIAL BOKASHI??

A problem is that the term "Bokashi" has come to mean "fermented food waste." That is simply not true. It is a confusing Japanese term that has only been in use for food waste since the 1980s using patented inoculants, while the practice of fermenting food waste has been in use for hundreds of years using indigenous microorganisms (IMO). If that is so, why do you need expensive Bokashi fermenters and patented inoculants (the microbes that do the work)? You don't! When I find "things that don't add up" on a website, it makes me less trusting of the information and recommendations. In some cases, they defy common sense and basic science.

Immediately go to a different site if the site states that Bokashi doesn't produce greenhouse gases. Again, this is simply not true. It will be obvious if you seal your waste in a plastic bag. There are thousands of other species in your waste when you ferment it. It is impossible to fully control which organisms will prevail in any batch of FFW at any given time.

Response: Fermenting food waste can and most likely will produce some GHG, although potentially less than aerobic decomposition.

Another claim is about the pH (acid or alkaline) of the Bokashi ferment. Some sites claim the pH is 3-4, which they call “fairly” acidic. I would call that very acidic and different than what I have encountered in hundreds of batches of FFW. It is not easy to accurately measure at home because cheap meters and pH paper strips aren’t very reliable. It is a logarithmic scale, so the difference between 3.0 and 5.0 is 100 times different. I usually find FFW in the 4.0-5.0 range, so it is in fact 10-100 times less acidic than these “experts” claim. They might want to review their chemistry.

Response: FFW is acidic and in the same range as tomatoes and kimchi, all in the 4.0-5.0 range.

Bokashi is usually done using special bran (the inoculant) fermented with patented microbes that can be expensive. It turns out that you don't need any inoculants at all in many cases. Since there are thousands of species of "fermenting" organisms, it will turn out that certain species seem to be better at some types of waste than others. If your waste contains lots of meat, you may find a mix of microbes designed for fermenting meat works better for you. I have tried various inoculants specialized for vegetables, bread, beer, and dairy. I found that whole wheat flour generally works best for me, is very inexpensive, and is only slightly better than no inoculant at all. The bran and husk already have microbes and spores on them (this is why unprocessed flour or bran must be cooked or processed before consumption). An advantage of very small-scale food waste fermentation is the ability to test and refine the inoculants that work best for you.

Response: In most cases, a simple or no inoculant is needed.

Many sites promoting Bokashi are also selling specialized bins. They are generally variations of the simple DIY systems based on five-gallon buckets. Along with the unnecessary inoculants, they are the "trendy" part of typical home food waste fermentation systems. Some are made in China, and they usually recommend two, one fermenting while the other is filling. They can cost from $50 to $150 each and are far larger than most people need.

Almost all of them claim to be odor-free, allowing you to compost right in your kitchen. There is little possibility of it being odor-free since most of the trendy bins are not fully airtight and the process is not free of gases. It might have a different odor than rotting food waste, but it does have an odor. It is often compared to a "pickled" smell (which is an entirely different process). If you sample different fermented foods, you will find that not all of them have "pleasant" smells. I will agree that it is not the smell of putrid, rotting food.

Response: There is no “universal” smell to fermented waste, and it can vary from “not bad” to “better than rotten.” It is rarely a pleasant “pickled” smell.

Most bins are not airtight, so odors will seep out. If you have a fully anaerobic container, you could have an issue with the inevitable gas production. In commercial systems, they are usually made of very strong material that can withstand the pressure of gas production and have lids that are clamped into place. Some have some sort of safety valve in case the pressure is excessive.

Response: The ALT method does not require expensive bins and recommends using innovative ways of repurposing rubbish.

Most will have a spigot system, which, according to the experts, will drain off the liquids during the process. Their reasoning is to keep it from "drowning" the reaction. This makes no sense. The organisms thrive in a liquid (they are grown in a liquid). It is the pH that halts the reaction. I suspect they recommend draining the systems since the liquid that accumulates can produce very strong anaerobic odors. I have experienced this with DIY systems that generally lack a drain. It can have a very sewer-like smell.

Response: Using the ALT method, there is no need to drain the liquids.

Another problem with the trendy bins is that they are too big. Most are in the 3-5 gallon range. If you don’t fill them to at least half to two-thirds full, they may not achieve microaerophilic or anaerobic conditions quickly enough. It will continue to decompose before the oxygen levels are reduced enough for the fermenting organisms to prevail. This is where some of the carbon and nitrogen can be lost.

Evidence of this is seen when a partially filled 5-gallon DIY Bokashi bucket indicates a potential fermentation problem. Mold or yeast might be an indicator of inadequate anaerobic conditions. This may not be a good sign, but most Bokashi sites claim it to be.

Response: Mold or yeast is probably not a good thing, as most websites claim.

When I ask potential waste fermenters how much waste they anticipate fermenting, most have no awareness of the volume or type of waste they produce. I would encourage someone to start small and scale up until they have more awareness of what they need. We first started with the typical five-gallon DIY bucket and found it took us about a month to generate enough waste to seal it and let it ferment. By that time, much of it was rotting and producing foul odors. The bin systems are of a fixed size and do not allow you to scale up or down according to your needs.

Response: With the ALT method, you can adjust your container to your lifestyle, rather than your lifestyle to your container.

One important point to consider is that our ultimate goal should be to eliminate or at least minimize food waste. That is difficult without awareness of the issue. Bin systems are designed to manage waste, and there is no incentive to reduce waste. It is easy to just dump your waste into some trendy system that allows you to continue generating waste without true awareness.

"Land, then, is not merely soil; it is a fountain of energy flowing through a circuit of soils, plants, and animals."

--- Aldo Leopold, A Sand County Almanac, 1949

CHAPTER 5: FERMENTED FOOD WASTE 101

Unfortunately, most of the science for FFW has been done on a large scale. At that level, they do things differently than most of the sites promoting and selling equipment for FFW for small-scale residential use.

FFW is not composting but rather a means to pre-compost food waste by fermentation, and it is one of the most primitive forms of microbial metabolism. Ironically, it is not recommended to put some food waste into a home compost pile because food waste easily rots and produces odors that can attract animals. Many of these animals have evolved smell receptors highly specialized for these odors. Food waste contributes a higher ratio of greenhouse gases than yard waste and is a possible source of pathogenic organisms. Many of the foods we eat have tough protective skins to protect the valuable nutrients in the seeds and fruits they contain. Some are slow to compost, such as avocado skins, which can persist in a compost pile for weeks or months. It is not recommended to put meat, dairy, fats, and oils into aerobic compost, but once those are fermented, they can readily be used in compost.

Compost piles are aerobic (with air) and produce heat (exothermic). Some compost piles can heat up to 82°C (180°F), especially municipal compost, which may contain sewage waste. Fermentation is endothermic (no heat), anaerobic (without air), and produces fewer greenhouse gases. It does not rot. That is why we ferment foods to preserve them. It also has a vinegary or pickled smell instead of a rotting smell that can attract animals. Since it is endothermic, it retains much of the nutrient value lost in the aerobic composting process. In addition to fermentation, preserving food helps make it more "digestible" by softening it. Cabbage is a good example. It is very nutritional, but much of the nutritional value passes through us because it is hard to

digest. When it is fermented into kimchi or sauerkraut, it becomes far better for us, almost like it is pre-digested.

A common byproduct of fermentation is lactic acid. When you ferment food waste, it gets acidic with a pH of around 4-5 (on a scale of 1–14, with 7 being neutral). This pH acts as a disinfectant and may even destroy pathogens. There are other fermentation pathways with different byproducts, like acetic acid and alcohol.

This process can happen in as little as a few days or weeks instead of weeks and months as in aerobic composting because it is pre-compost. Since the pH can make a garden acidic, the ferment is placed in the soil or compost for two or three weeks to neutralize it before planting. Lactic acid combines with the water and changes to lactate, which is an energy source almost all microbes can use. So, microbial activity dramatically increases in the soil, and the ferment effectively provides nutrients for both plants and microbes, thus being a valuable soil additive and increasing soil fertility. Because the ferment is soft and pre-composed, it is assimilated far more rapidly than by aerobic decomposition. The timeline for food waste to finally be used by a plant is reduced from months, or even years, to weeks or months by first fermenting it.

So, fermenting food waste saves time, provides nutrients, reduces greenhouse gases, and becomes a valuable soil additive that will increase soil fertility and produce healthier plants, and it is easy to do.

I have also observed an increase in worms in the surrounding soil, or compost. I compost all year, even in winter (in Eastern Washington State), and adding fermented food waste to my compost pile has become an essential part of my composting technique.

ASSIMILATION INTO THE SOIL

One of my big disappointments with traditional Bokashi is that it is not very applicable to areas with short growing seasons or for year-round use. Most will tell you to bury the ferment in the soil a few weeks before planting to let it neutralize since it is acidic. Most proponents never test how long it actually takes to assimilate into the soil.

The ferment actually needs to undergo decomposition to be available to plants. A good analogy for this process is something we all know about: sauerkraut. Cabbage is very nutritional, but it is not very digestible. While cooking makes it more digestible, it also loses some of its nutritional value. Fermenting it retains its value while making it more digestible (almost like pre-digesting it) and also preserving it at the same time. Our ancestors used fermentation for preservation, which also made vegetables more digestible. Kimchi is a similar process.

Just like sauerkraut, the buried ferment is more “digestible” and happens more quickly without thermophilic microbes. In composting, the thermophilic phase is where high temperatures are produced, typically averaging 66°C (150°F). This is where the majority of greenhouse gases (GHG) are produced. This is why fermentation can take only a few weeks to decompose instead of several months to make mature compost.

Recall that the lactic acid produced is converted to lactate in the soil, and this is a primary food source for almost all microbes. Microbial activity and reproduction increase dramatically, and this helps break down the ferment by decomposition as well as other organic material in the soil (compost, for example). During this "assimilation" process, the acidic ferment is neutralized.

I don’t bury my FFW in my garden; I bury it in my compost pile. We use lots of compost for soil structure and water

retention. When I evaluated compost using Pfeiffer Circular Chromatography (PCC), I found that most commercial compost, while high in organic matter, was not very microbial. Much of the commercial compost contains sewage sludge to raise the organic content, and it is heated to high levels to kill any pathogens. In the process, they also kill non-pathogenic microbes. Using compost teas (very high in microbes) or FFW and letting the compost mature longer resulted in far better compost. We now have enough yard and garden waste as our landscaping matures that there is no need for any external compost. I found that when adding un-chopped FFW made in my own DIY Bokashi bucket to my compost, the FFW can persist for months before it is assimilated. This is contrary to the claims made by the Bokashi promoters. Using the ALT Method for FFW reduced the assimilation time dramatically by chopping and ideally pulverizing the ferment.

CHOPPING OR PULVERIZING THE WASTE

Large-scale systems first pulverize their waste before fermenting it. Just as aerobic decomposition is more efficient when the material is shredded, FFW is more efficient when the material is first chopped.

Most Bokashi instructions don't mention chopping the waste; just throw it in the bucket. That is like saying, "Don't chew your food; swallow it whole." The ferment will persist in the soil for several weeks if it is not chopped. Pulverizing it is optional, but it will greatly decrease the assimilation time into the soil or compost. None of the bucket systems even mention the possibility. Even pulverized ferment is sometimes not fully assimilated in two weeks, but it is adequately neutralized for plants.

To duplicate what is done on a large scale, I began to test methods for pulverizing the ferment. The most practical solution was to use a low-cost immersion blender. Depending on your food waste, this is not easily done prior to fermentation. Avocado skins are a good example. They are

difficult for a low-cost blender to pulverize. However, after they are fermented, they are far softer and blend easily.

Figure 6.1 shows a citizen science “experiment” I did to test soil assimilation. On the left is some chopped waste after fermentation. Half of this FFW was pulverized by blending. They were buried in the same compost pile to get equal treatment. After two weeks, you can see the chopped material (middle) is not nearly as assimilated as the pulverized ferment (right). Imagine how it would look if it had never been chopped at all. It is a myth that traditional Bokashi will disappear in a few weeks.

FIGURE 5.1: ASSIMILATION TEST (CHOPPED IN MIDDLE VS. BLENDED ON RIGHT)

SMALL-SCALE PULVERIZING

There are alternatives to everything, but not all alternatives apply to every situation or need. This is why you need a small, scalable system that allows you to find what best fits you.

The problem with large bins for those who don’t generate enough waste to fill them in a short time is that the waste rots. This is where it gets smelly and attracts fruit flies. There are ways to pulverize your waste prior to fermenting it, but it can also speed up decomposition if you delay fermenting it.

I have found the ideal small-scale method is to first chop your waste by whatever means fits your situation. I use kitchen scissors and do it as I take the kitchen waste to the holding container (in our case, a repurposed half-gallon yogurt container). After fermenting it in my favorite fermenting container, the half-gallon cardboard milk container, I can easily pulverize the softened material with an immersion blender or a repurposed kitchen blender from the thrift store.

FIGURE 5.2: PULVERIZING ALTERNATIVES

I tried a 500W immersion blender that at the time was under $13 on Amazon. This hand blender worked really well directly in containers like a milk carton and is all I now use.

Pulverizing is ideal, but optional. At a minimum, your waste needs to be chopped.

YEAR-ROUND FERMENTED FOOD WASTE

Another problem with residential Bokashi is doing it on a year-round basis. All those selling expensive bins (many recommending two) only have instructions to bury the waste

prior to planting. We have a short growing season and only plant once each season. Half of the year, our ground is frozen, or at least cold enough to reduce microbial activity.

“Soil factories” are an assimilation process that can be scaled down to a tub of soil where ferment is added to it, but only in very small ratios. There needs to be more science done on how much and how often ferment can be added without over-acidifying the soil. Most of the Bokashi promoters overemphasize the use of soil factories.

There are two easy solutions to the problem of year-round fermentation of food waste where climate is an issue: using it in a compost pile instead of directly into the soil is one.

I have experimented with winter composting. We have long and cold winters and average about four feet of snow annually. Most of the material to compost consists of leaves, pine needles, and cutting-back plants in preparation for winter (carbon-rich and nitrogen-poor). I have been building my compost piles in late fall and using compost teas (a way of growing soil microbes) to help them reach thermophilic temperatures. I cover them to retain heat and prevent them from getting too wet. I closely monitor temperatures so I know when to uncover and turn them. As I turn the piles, I "reenergize" them with compost tea (aerated and heated for maximum microbial growth). It is actually enjoyable to work in the warm compost when everything else is buried in snow. By late winter, they have cooled to "resting" temperatures of around 10–21°C (50–70°F), depending on the severity of the winter, but they never freeze. In the spring, it will be essentially done and ready for use. Upon testing, this has been some of my best compost.

This past winter (2022), I used FFW as the primary way to keep the pile active. While I have good results with compost teas, they are very labor-intensive, and in the winter even more so. It was far easier to keep the piles going with FFW. It is also rich in nitrogen and gives me a better carbon/nitrogen

ratio. Worms are a good indicator of this. When I would encounter pockets of ferment when turning the piles, they were loaded with worms that would normally be spending the winter underground.

The second solution to the year-round fermentation of food waste, which is not discussed by the Bokashi enthusiast, is that it is preserved. Preservation is one of the important tests to confirm the waste is indeed fermented. If it doesn't rot, it is fully fermented.

Since the containers used in the ALT method are essentially free or of minimal cost, the preserved ferment can be stored until needed without opening them. The expensive bins need to be immediately reused if you plan on fermenting your winter food waste but not using them until spring. You are supplying the fermenting containers for the ALT method, and this becomes one of the most significant features of the method. There is a chapter just about the evolution and advantages of containers using the ALT method. It is a year-round solution.

So, you can store your FFW until it can be used by you or someone else. You can give it to a community garden, a friend or family member that gardens, or if there was a municipality that could collect it, they could stop burning or burying it. It is actually a marketable soil additive when done on a large scale, like in a municipality.

THE PROCESS IS TEMPERATURE-DEPENDENT

In general, plants grow best at 21–24°C (70–80°F); it is no surprise that this is about the ideal temperature for making compost tea and the ideal temperature for maturing compost. So, why do residential Bokashi bins rely on ambient temperatures? Once the "bubble bursts" about keeping your trendy bin in the kitchen, it will probably end up in some area not ideally heated. We don't even keep our house that warm in the winter. Since I like to FFW all year-round, it needs to be done indoors, and the ideal space is the basement.

When using my sophisticated instruments of sight, feel, smell, and pH testing, I found it takes far more time to fully ferment than the Bokashi sites state. My DIY bucket would take several weeks to ferment in the basement. Since I had already done research on compost tea and I am a trained microbiologist, it made sense that FFW would be no different relative to temperature. Not only do my methods try to debunk the mythology of these techniques, but it is critical to me to keep the technology simple and low-cost for real people. Each spring, we start our garden plants indoors on seed mats. They are safe, available, low-cost, and low-energy. In the past, I have used one under my worm bin in the winter. I could feel how happy that made them, just like the heated seats now in most cars make us happy.

FIGURE 5.3: SIMPLE DIY "INCUBATOR"

So, the obvious choice was to insulate one of the storage tubs with bubble wrap, courtesy of everything shipped to us. The tub then sits on a seed mat in the basement. It provided a

consistent 24°C (75°F), and depending on the size of the container and the type of waste, it would be completely fermented in 3-5 days. You can't over ferment the waste, and I just leave them in the "incubator" for a week (since we do about ½ gallon each week).

WHITE MOLD: I DON'T GET IT (LITERALLY)

When I say I don't get it, it has two meanings. I don't find this alleged white mold in my ferment that according to the "experts" proves your fermentation is working. I did find it in my ferment in the DIY Bokashi bucket, but never in testing of the ALT method. The second meaning is one of dismay about the Bokashi sites. I am not convinced they have a full understanding of what they are promoting.

I suspect it is not mold, but more likely yeast. Since they are both fungi, let me analogize this in a way that explains why it is of concern to me.

If we are bird watching with an "expert" bird watcher and a duck lands in the water and the expert calls it a seagull, we might question the expert. If the expert says it doesn't make a difference since they are both birds, then I would doubt the expertise of the expert. Yes, molds and yeast are fungus, but they are not the same thing, like the duck and the seagull. I question whether the Bokashi experts who are telling us it is mold are indeed experts. As a citizen scientist, you can figure that out (I am giving you a challenge).

Most molds and yeasts are obligate aerobes. If FFW is anaerobic and more likely microaerophilic, then I would not expect to find them in the fermenting container. In the hundreds of fermentation tests I have done, I have never encountered visible mold or yeast using the ALT method. That doesn't mean it can't happen; it just means it might be unlikely.

FIGURE 5.4: IS IT A MOLD OR YEAST? THE "EXPERTS SHOULD KNOW"

When looking at photos from websites about fermenting vegetables (commonly found in food waste), I learned about Kahm yeast (on the left). While harmless, it is an indicator of a fermentation failure. This group of yeast is oxidative, which probably means the low or no oxygen environment was not achieved (higher levels of oxygen were present). The photo on the right came from a Bokashi site, calling this a mold and stating that this is a good sign that the Bokashi is working.

Most of us have seen molds, which are generally fuzzy and filamentous. Kahm is described as creamy. Looking at those photos, it would appear they both might be yeast. My recollection of my Bokashi bucket was that it was indeed creamy rather than fuzzy. The bottom line for me is that I am not sure the "experts" are as expert as they claim. It may not matter if it is mold or yeast; both indicate possible aerobic conditions, while fermentations is anaerobic, or at least microaerophilic, The controversy just makes me less trusting of the claims made by the experts. I don't claim to be an expert on anything. Science is proving many of the experts wrong as we learn more nuances about life. It may seem insignificant if it is mold or yeast, but both are not good signs of fermenting technique or the possible expertise of the "experts.".

CHAPTER 6: MY CONTAINER: IT'S JUST RUBBISH

When I first considered alternatives to my 5-gallon DIY Bokashi bin, I did not fully understand FFW. Like most people, I relied on the "experts," who all parroted the same advantages, hypes, and myths.

Because it was promoted to be strictly anaerobic, I had to find a way to scale it down and keep it anaerobic, low-tech, and low-cost. I began testing food storage vacuum bags. They are very sturdy reusable bags with a "zip" closure and a small one-way valve that allows the user to remove all the air and vacuum seal the bags. The biggest drawback to them is that you need some type of vacuum pump to accomplish this. While they worked very well in my initial trials, the pump was a stumbling block.

One of the immediate myths, that Bokashi does not create greenhouse gases easily, was proved wrong. The bag would inflate with gas, but it could be simply removed with the pump without exposing the ferment to oxygen (anaerobic). Several people began using the small kits I provided with a small manual vacuum pump. The problem they encountered was that it was difficult for the pump to seal on the valve when the bag was inflated. One of the users (thanks, Kris) had no choice but to slightly open the zip enclosure and force the gas out to the point where the vacuum pump could finish the job. Then it seemed to work without any problems.

From that experience, I began using regular food storage bags without the valve and learned to roll the bag from the bottom with the seal slightly open until the gas was removed and then resealed. I called the technique "burping" the bag. This simplified the container considerably.

Because the bags are available in several sizes, I was able to begin testing many different hypotheses. Much of it was done in one-quart bags that could be used repeatedly. I could split a single batch of food waste into several bags and test different

inoculants. I could test the advantages of incubating the bags as well as different types of waste.

Over a period of a few years, I have determined that FFW is more likely microaerophilic (with very little oxygen) than anaerobic (with no oxygen). I determined that many common inoculants can be used and that some work better on different waste than others. For our type of waste, whole wheat flour worked as well or better than the expensive Bokashi Bran and only slightly better than no inoculant at all. That is right; no inoculant on many types of waste works just fine. It became very obvious that doing the fermentation in a simple incubator (a tote sitting on a seed-germinating mat) was far more efficient. I was able to see which waste produced gas and odors, and I began to have a far deeper understanding of FFW.

In the process of doing citizen science, I had to journal what was in our waste and how much we produced. That awareness might be the biggest advantage of the ALT method. We have now reduced our food waste to about ½ gallon of chopped waste per week. It is mostly fruit and vegetable trimmings. We get some occasional spoiled bread, cooking oils, and dairy products, but very little meat. Now we try to find ways to eliminate even some of that waste. I think zero waste is impractical, but knowing that we can reduce our waste and learn at the same time is a tremendous advantage. The 5-gallon Bokashi bucket would not have been as enlightening as the learning curve we gained from the ALT Method.

IT STARTED WITH BAGS AND EVOLVED INTO RUBBISH

While the bags were instrumental in letting me see and feel the contents during the fermentation process, I am now 100% confident that the FFW process is far more forgiving than I thought and is almost impossible to not work. This allowed me to experiment with alternatives to the bags.

FIGURE 6.1: ENDLESS POSSIBILITIES FOR RUBBISH CONTAINERS

I began looking through the rubbish for containers that we could not recycle. I found an empty Kirkland prune bag that was very sturdy, had a flat bottom, a zip closure, and held our typical weekly waste. Not only did I find that, I also found a butter tub, a cheesecake container, and a bread bag. In the kitchen, I also tried a compostable food storage bag and some single-purpose produce bags longing for a new life.

I made some FFW, sprayed it with water, and inoculated it before putting it in any container. Each of these containers was then filled to about two-thirds capacity and sealed. The bags all had the advantage of being burped before sealing.

I incubated them all at once, and while there was some gas production, I did not open or burp any of them. After 5 days, I did burp the bags so they would stand up for a family picture before opening them all.

Each had an equal pH of 4.5, produced liquid, was soft, and had the typical fermented smell. The compostable bag is designed to "breath," and much of the moisture had escaped through the bag and condensed on the inside of the incubator. It was obvious that more research needs to be done on compostable bags (although they are very misunderstood). My gut feeling is that they are not a viable candidate as an ALT container. I then proceeded to blend each of the contents to see if any were less fermented than others, and they all seemed to blend as usual (I add additional water to the top of the ferment so it turns over easily in the low-powered repurposed blender).

My conclusion is that they all worked well, especially the bags, which had the advantage of being more microaerophilic than the rigid containers. The prune bag was clearly my favorite, and it advanced to the next round, while the others had an honorable demise because they weren't as practical.

FIGURE 6.2: HALF GALLON MILK CARTON WORKS GREAT!

The next round was a trash can nemesis of mine: the empty ½-gallon cardboard milk carton. It takes up lots of space unless you crush it first and replace the lid. This one was resurrected after having been crushed. I opened the top to spoon in some prepared waste, taped the top shut, and incubated it. It never appeared to expand with gas, and had it done so, I was going to vent it by just loosening the screw cap. It also produced excellent FFW. The prune bag with a flat bottom, the ability to squeeze, and a very narrow, clear part to see through slightly is my favorite. However, we use about two ½ gallons of milk in cartons each week, as well as other juices and dairy products, and it will be far easier to build up an inventory of empty cartons, so for us, the ½-gallon cardboard container best fits our needs and resources.

A huge advantage is that I can give them away since they were rubbish to begin with. If someone wants my half-gallon milk container with ferment, I can gladly share without giving up a container I purchased or need.

I will continue to use pint and quart food storage bags for testing purposes, but we no longer need to use anything but rubbish to ferment our waste. Wow, a two-for-one!

I hope you can see that the ALT Method allows you to experiment with what meets your needs, goals, and passions. In the process of learning what containers, waste, inoculants, and techniques you choose to use, you will now understand them far better than the "experts." Your recipe will be unique to you, and you won't need to follow their "one size fits all" mentality.

"We are part of the earth and it is part of us ...
What befalls the earth befalls all the sons of the earth."

--- Chief Seattle, 1852

CHAPTER 7: HAVE A PLAN

My research has been done in eastern Washington State. We have hot, dry summers and cold winters with lots of gray skies and moderate snow. My wife and I are typical average residents, and we live in an older home in a long-established neighborhood within the city limits (a large but not giant city). We have a larger-than-normal yard with lots of space for a composting area and lots of materials to compost. We are retired and don't produce the waste that a large family with children might. We care about the Earth and the legacy we will leave behind, but we are not extreme in our pursuit. We are retired professionals that know how to use the Internet, and both are college-educated in science. The point is that unless you have the same profile, your needs and use of FFW will be different.

You need to do research on FFW. You will find most are Bokashi sites, and obviously many of them are passionate about their products and the information they provide. A bit of a warning about wikis: many of them are written from very specific perspectives. I use them, and I think the concept was great, but like everything today, they are getting co-opted by individuals or groups with sometimes unusual scientific biases. We all need to apply good logic and common sense to what we find on sites that are not peer-reviewed by reasonable and knowledgeable people in the discipline. Consider my perspective in the same way; we are all biased. When you find conflicting information, consider how you could figure out which one fits you best.

An important part of your plan should be how to avoid food waste in the first place. There are many resources for tips on how to do this. But not many of us know how much waste we generate and where we can maximize our efforts at reducing it. It is simple for us because we have minimized our food waste. Therefore, it takes minimal effort to ferment the remaining food waste.

After your research, consider your goals. Why do you want this, and is it feasible and practical for you? To do this, you need to be aware of the resources you have.

- How much and what type of waste do you have?
- Where are you going to store the materials, and how much time will it take?
- What will you do with the ferment when it is done?
- How are you going to determine if it was helpful and met your goals?
- What is it going to cost?
- Can you start small and scale up, or do you have to start with more than you will ultimately need?

My recommendation is to start small, journal what you do, and focus your testing on things that will help you solidify your understanding of FFW. Start with the easy waste first. Save the meat, bones, dairy, grease, and so forth until you gain experience. If your goal is to reduce waste to zero, make it a reasonable path to follow. If you invest heavily in a plan that doesn't work, you will have unused equipment like my DIY bucket that I will eventually repurpose when I find a use for a bucket with holes in the bottom.

While food storage bags like the quart and gallon Ziploc® Freezer Bags I started with are great for testing, I eventually hit on a system that works for me, and all I spend is 50 cents for a pound of bulk whole wheat flour, and the rest is rubbish and waste.

"... the soil of any one place makes its own peculiar and inevitable sense. It is impossible to contemplate the life of the soil for very long without seeing it as analogous to the life of the spirit."

--- Wendell Berry, The Unsettling of America, 1977

Have an intermediate container for collecting your waste. We used a 64-ounce, repurposed yogurt container. A great way to involve children is to have them decorate it so you can keep it in your kitchen or utility room. Chop your waste into the container as you generate it. Depending on your environmental conditions, do this until it either starts to smell, heats up a bit, or attracts fruit flies. That would be your limit. Adjust the collection container size to fit that limit. We fill our container weekly, and that is about the limit of when we might see a fruit fly or two (indicating it is ready to ferment).

> *Hint: I use kitchen scissors to cut the waste reasonably small. Hard things like carrots make me nervous if children are doing this. Hard things are best chopped with a knife on a cutting board and may require adult supervision. A technique that works well using scissors is to put the waste in the container and use just single-handed cutting with a downward motion in the container. A finger is not the kind of organic waste we want. Use caution!*

I do not wet or inoculate the waste until I am ready to ferment it. This will slow down decomposition in the collection container. When the container is full, I use a spray bottle to completely wet all the material, mixing it as I go. I may use several fluid ounces of water if it is really dry material, like orange peels. You want it to the point where water starts pooling on the bottom. You actually can't over wet it. It is better to be fully wet than less wet. Next, sprinkle your inoculant (in my case, whole wheat flour) to lightly coat all the waste, mixing as you go. In a half-gallon fermenting container, I use 2-3 tables of whole wheat flour, but try different kinds and amounts to find the best results for you.

Hint: Test various inoculants. I have tried various probiotic capsules that contain different strains of Lactobacillus (there are many of them on the market since probiotics is a popular topic), as well as sourdough starter, kefir (a fermented milk that worked well), various yogurts with live microbes, unprocessed wheat bran, and some starters for fermenting vegetables. There are also fermentation products for meat. If your waste doesn't do well with the inoculant you are using, then experiment. I considered cost and availability when deciding on whole wheat flour (it is unprocessed and has the bran included). You can even try some commercial Bokashi Bran to satisfy yourself; it is not needed.

Transfer it to the repurposed container you intend to use for fermentation. If I am using a prune bag or a food storage bag, I fill them about two-thirds to three-quarters full and burp out any excess air. If I am using a rigid container like a milk carton, I fill it almost to the top to reduce the amount of oxygen in it before it becomes microaerophilic (very low oxygen, almost anaerobic). I journal times, dates, contents, inoculants, and container information since it is a constant learning experience.

I highly recommend using a simple incubator. I just use a tub sitting on a seed germination mat (10x20 fits the bottom of my tub). If you don't have an incubator, store your fermenting material in a place that is consistently warm, if possible. Don't overheat it; just a comfortable 24-27°C (75-80°F). If that is not possible, it will take longer, as long as it is over 10°C (50°F). You can't over ferment it, so let it go as long as you can. Test it by feeling; you want it soft and mushy.

FIGURE 8.1: BAGS MIGHT NEED BURPING (THEY EASILY INFLATE)

Check for gas production at 12 and 24 hours after incubation, or check it every day or two if it is not incubated. Burb bags: undo a small part of the zip closure and roll the bag up from the bottom until the gas is expelled, and then reseal.

Be careful if it has started liquefying the contents; do not force liquids out. This is also an easy way to check the pH after several days. Force some liquid to the top and saturate a strip of pH paper. If you are using a rigid container and it is not bulging, don't worry about the gas. If it feels firm or bulges you can slightly open a lid, and the positive pressure will keep air from entering it.

> *Hint: Bags tend to easily inflate with very little internal gas pressure. More rigid containers seem to contain the pressure without any need to worry. But always be aware that gas is building up and anticipate a container bursting or leaking. Large-scale systems sometimes have a pressure release valve. If you are not sure, vent*

it, but try to minimize how often it is vented. Gas production usually lasts only for a day or two. Figure 8.1 is a bag of spoiled beef tamales. It produced more gas in 12 hours than any I've ever tested. I wish I had not burped to see the outcome, but again, assume the worst and make sure you are prepared for it. This would not have been dangerous if it burst, but it would have been messy. I have not tested glass or metal containers. If you try them, then be very aware of gas. Spoiled beef tamales produce gas. Go figure.

When containers like a milk carton are overfilled, some liquid might be forced out the top. Remember that next time you fill them.

Even if they appear done after 3 or 4 days, you can't over-incubate. I leave them in until I am ready to add the next week's FFW. If I don't have an immediate need to use the ferment, it can be stored in a cool place (but not in a freezer).

Hint: Contrary to the explanation that it is necessary to drain the liquids from the fermentation container because it will "drown" the reaction, it isn't. The microbes don't have legs and exist in wet or liquid environments. The patented microbes used in the Bokashi world are actually sold in liquid form. My gut feeling again is that the liquid in the bins with a spigot allows the liquid to go to the bottom, where it becomes anaerobic and really smells foul if it is not drained off. This is exactly what I experienced in a DIY system where the liquid gathers at the bottom but does not have a drain. When you finally open it and pull the inner bucket out, the smell from the outer bucket will remind you of an outhouse. The liquid in the ALT containers does not go foul, and I have retained some containers for several months with absolutely no signs of putrefying. Rinse them between uses, but don't use any soap if possible.

FIGURE 8.2: DIFFERENCE BETWEEN CHOPPED AND BLENDED FERMENT

I highly recommend fully pulverizing your finished ferment when you are ready to use it. I have tried smashing it with a fork and a potato masher, but I could not get the results I liked. Perhaps with very small amounts, that would work. A blender, on the other hand, will give you a fermented smoothie. The one on the left is just chopped ferment. On the right, the chopped ferment after just a few seconds with a blender.

Usually, you can find low-cost blenders in the 600–700 watt range. You might be able to rescue or repurpose one. Dedicate the blender to non-food use; never use your kitchen blender. The immersion blender turned out to work best for me. It was the best value, the fastest, and could be done directly in containers like a cardboard milk container.

I always emphasize this several times. Blending the soft ferment will speed up the assimilation time in the soil, and you will get far better results than the Bokashi experts claim. Pulverizing the waste prior to fermentation is done commercially but is not practical for small-scale methods.

You are now ready to bury it in the ground where you intend to plant your garden or in an active compost pile. You will want to do this when the soil or compost is warm enough to have active microbes that will continue to break down the ferment. I have stored the blended ferment for several days without any indication of rotting, but you will need to do some testing if you want to store it for longer periods of time (unblended, it will last for weeks, perhaps months). Avoid the root zone of established plants. You can use trenches where you are going to plant row crops. Make sure to cover it with soil, and you can even mix it in. Wait at least two weeks before planting to make sure it is fully neutralized.

> *Hint: I would not recommend using FFW for indoor plants. Even container gardens might be sensitive to acidic soil if it is not fully neutralized. This would apply to soil from a small soil factory where excessive ferment has been added. I have not experienced any problems using ferment in my compost piles, but mine are large and very active with microbes. If you do this with poorly managed compost or a very small pile that is inactive, it could alter the pH. Always start small and scale up as you see the results. If I were using this with worm bins, I would first mix it in small quantities with old food and bedding material to buffer it. I understand worms will adjust to the pH and readily consume it. This is also true of coffee grounds. I do see vastly more worms in my compost pile, often directly in the areas where the ferment was placed.*

A good “rule of thumb” is to keep your waste as diverse as possible. Just like our gut biome, fermenting food waste works best with a diverse mix of microbes.

CHAPTER 9: YOU CAN'T FAIL

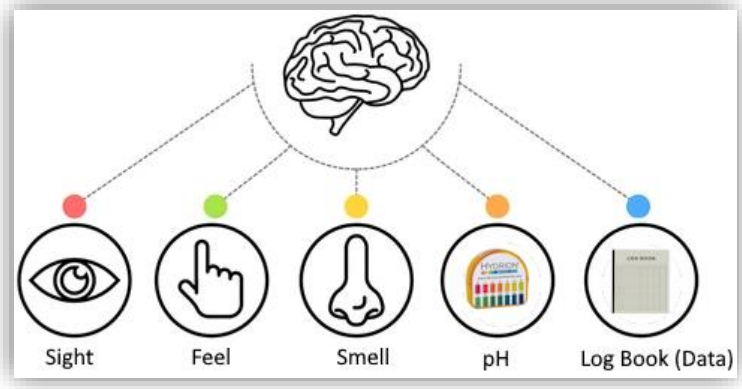

FIGURE 9.1: THE COMMON SENSES OF FFW

Use vegetable scraps, fruit peels, and table scraps when first learning about fermenting food waste. Avoid excessive coffee grounds, excessive meat and dairy, and large amounts of grease until you get the basics down. Then use these simple tests to evaluate your success after one month.

Your fermented waste should not smell rotten or putrid. Much of the waste should retain color rather than being black and moldy (fuzzy). It should have decreased in volume and may have more liquid than before fermenting. When you squeeze the ferment, it should be softer and more pliable.

If you have a soil pH meter or pH paper, you will find it has become acidic (4.0-5.0). But the real definitive test is that it did not rot for weeks or even months in an unopened container. Keep in mind that fermentation was used for preserving foods over long periods of time, and this is why time is a good indicator of success.

It is far better to do hundreds of small batches of FFW than it is to do a few batches in an oversized container. You will collect far more data and experience.

What if it failed? Just dispose of it in the ground, compost, or in the manner you would have previously used. You did not have to invest in expensive bins or inoculants. But channel your inner scientist and come up with a hypothesis about why it flailed.

Perhaps you need to try a different inoculant or a warmer location to ferment. Was the container anaerobic (lacking oxygen) or at least very close (microaerophilic)? Was the waste already extremely rotten before trying to ferment it?

There is a saying I have heard about science that I can't find to properly quote it, so I will have to paraphrase it: "Science is all error, until it is not."

The ALT method is very simple, and most everyone who puts a bit of effort into it will be successful almost every time. We (my wife and I) can't see a reason not to do it. We have reduced our food waste almost completely and also repurposed rubbish, improved our soil and compost, and now we give Milk Carton Challenges away so no milk carton gets wasted.

We all want a win-win situation. I see the ALT method as a win-win-win-win. I like those odds!

CHAPTER 10: SOIL AND COMPOST FACTORIES

Probably the single most common reason people don't ferment food waste is that they don't see a use for it. They may not garden or just have a few container plants. They buy compost because making it requires labor or resources, and they might be unaware of what a massive problem food waste is as well as declining soil fertility. Those promoting and profiting from Bokashi often provide information about "soil factories" as an alternative to these problems.

A soil factory is just a tote or large container with soil where FFW can be added so it can neutralize the acidity. The myth of the soil factory is that it is very heavy, difficult to mix, and often too dry. If you want to ferment food waste on a regular basis, it may get acidic faster than it can neutralize your ferment. What if you used compost instead of soil?

I personally would never use commercial compost. Even though it may be high in organic material, it could also be high, but within EPA standards for toxins and heavy metals. Municipalities, large-scale agriculture, and industrial waste are sold to huge composting operations, including sewer sludge. To meet EPA requirements, it is forced to heat up to high temperatures to kill pathogens.

FIGURE 10.1: HOW FFW IMPROVES COMMERCIAL COMPOST

On the left in Figure 10.1 the Pfeiffer Circular Chromatograms (Chapter 16) shows a high content of organic matter with little microbial life to break it down. After mixing a gallon of food waste ferment into a tote full of this commercial compost and letting it mature for a few weeks, it is coming “alive” (in the middle). A second round of FFW and a few weeks later, it is more like what I would expect when evaluating acceptable compost (on the right).

I have seen many composting tumblers that are sitting unused because many just don’t work. The compost “experts” are promoting a myriad of worthless composting bins that supposedly eliminate labor and the “unattractiveness” of a compost pile. In my opinion they are as worthless as expensive Bokashi bins. They usually end up unused. However, they may have a use as a “compost maturing facility”.

Since you are putting composted material in them they would need far less management than they require for making compost. Just moisten the compost, add fermented food waste (hopefully pulverized, turn now and then and you should have far better compost after a reasonable maturing period than you started with.

If you are using too small of ‘soil factory” you should monitor the pH. Avoid changes greater than 1.0 from the initial pH, for example 7.0 to 6.0. Keep in mind pH is difficult to measure because cheap meters and paper strips only give you approximate values. You may want to test germinating some seeds in a soil sample before fully using it.

Since compost is added to soil it will “dilute” the pH of the compost. Even if the compost is slightly acidic it will be less problematic than soil.

CHAPTER 11: THE MILK CARTON CHALLENGE

At a recent presentation, I came up with the Milk Carton Challenge to encourage the attendees to meet three goals:

- To achieve the most simple way to get them to try FFW.
- To encourage them to share their new knowledge with others.
- Have some fun.

In the process of turning food waste into a valuable soil additive, it is also removing a milk carton from the waste stream or repurposing a plastic container like a prune bag.

The ideal "countertop" container will be wide enough to easily add your food waste. We chop ours with kitchen scissors directly into the container. You will want one with a tight-fitting lid to discourage odors and fruit flies. Use one that is equal to or close in size to your fermentation container. A perfect match for us was a 64-ounce (half-gallon) yogurt container and a half-gallon milk carton. We painted our collection container and look forward to when the great-grandchildren can really "craft" one that will be perfect for us.

Just as a reminder, the advantage of milk cartons is that they are rubbish; they can't be recycled and are difficult to repurpose. They are a container you could easily give away since most homes have the potential to generate one or two per week. We deliberately buy our milk in cartons to avoid plastic jugs.

MAKING THE CARTONS IS EASY

There are templates for making the cartons and flyers that you can download from the Resources chapter. Print several so that each time you empty a carton, you can make one to give away if you don't need it.

Simply cut out the panels that get pasted or taped to the cartons. They are a very condensed summary of this book. I use Elmer's Washable School Glue Stick, which seems to work well on the waxed cartons to initially hold them in place. I then cover them with clear packaging tape to increase the "lifespan" of the cartons.

Carefully open the top of the carton, then close it and put some heavy-duty paper clips on it to keep it shut.

> *Hint: After opening the carton top, pull the opposite corners out to open the glued portion.*

FIGURE 11.1: EVERYTHING NEEDED FOR THE MILK CARTON CHALLENGE

Make sure to do a carton yourself, so you are not promoting something you have not done yourself. Keep in mind that this makes your contribution far more powerful. When we all do a little, we all gain a great deal. This is the power of "crowdsourcing."

Most people do not even know how much usable food waste they throw away. Once they gain awareness, they will now have a solution to the problem. This will benefit the soil and the earth's health, as well as our own. You are helping the world, one banana peel at a time. The panels will work on ½ gallon and quart cartons. Each sheet will make one carton.

FIGURE 11.2: LINKS FOR TEMPLATE FILES ARE IN THE RESOURCES CHAPTER

There is also a flyer sample, or you can make one that fits your needs. This is a great thing to get your friends, organizations, schools, and even your legislators involved in. Let's all make a challenge where everyone wins, including the Earth!

SHARE IT WITH EVERYONE!

We will no longer throw a milk carton in the rubbish. It is a container I can freely give away. I print labels to stick on them with simple instructions on how to do the ALT method for FFW. I take them to community gardens, school gardens, friends' gardens, and everywhere I can. This will be difficult since we don't generate that much waste, but what if more people were doing this?

This was the origin of the Milk Carton Challenge (next chapter). If we make three cartons with instructions right on the carton and give them to three people who take the challenge and they do the same, our miniscule contribution is multiplied. We are committed to doing this; even if nobody else does, we can say we tried. This doesn't require countries, states, and cities mired in political and economic issues to act. It can be done on a personal level, right in our own homes.

What about the growing numbers of people living in apartments and condos? What about all those who rationalize that they have nowhere to use the ferment? They do have a way to use it. What about introducing it to your children's science teacher and encouraging them to add it to the curriculum? What about having the city create collection points for those thousands in our city that won't pay extra for a green bin and simply put their food waste in the brown bin that goes to the incinerator? Where does it go, then? It goes up the smokestack, contributing to greenhouse gas emissions. What a waste of carbon and nitrogen!

How about a proliferation of websites far beyond those touting Bokashi myths sharing Citizen Science data on improved health, growth, and yields in their gardens? We know social media can have a large impact on everyone (good and bad).

CHAPTER 12: MY TAKE ON CITIZEN SCIENCE

Often in this book, I have mentioned citizen science (CS). Like everything, there are multiple views and definitions of CS.

One of the most common definitions is "a science project directed by a professional scientist that monitors and uses data generated by CS." The problem I have with this definition is that I am not sure if science research is driven by science or by corporations that support the "scientist." The solution to this conundrum is to not focus on the scientist but on the scientific method.

This is not a new problem since scientists either get their support from a patron or have a financial interest in the outcome of their research. So, eliminate the profit motive. We all learned the scientific method, or at least did in the past. I remember learning it and thinking that it was just common sense.

This is my very simplified understanding of the scientific method:

- Make a hypothesis or prediction.
- Keep the data and details well documented.
- Test the hypothesis in a way that keeps all things equal except for one aspect (variable) of the hypothesis.
- If the test doesn’t refute the hypothesis, isolate different variables and repeat testing.
- After eliminating all the variables without refuting the hypothesis, have others repeat the procedure and allow others to try to refute it.
- If the hypothesis stands up to more testing and challenges, then the hypothesis may deductively be useful in forming new predictions or hypotheses.

During my teaching career, I struggled with the demise of common sense among my students. Nobody can quite define what common sense is and how to teach it, but as it declined, so did science test scores. Often, it is associated with "gut feelings" that ironically may involve our microbial biome, which has become less diverse and is now being attributed to increased health issues.

So, my view of CS is that it is science that anyone can do, and it incorporates the scientific method, uses common sense, and can deductively lead to more predictions.

The ALT Method of Fermenting Food Waste is very easy to test using simple citizen science. It is a way of bringing back common sense by reintroducing the scientific method. I found that when I told my students to use and apply the scientific method, they were far more receptive to the suggestion than if I had said, "Use your common sense." While the two are the same to me, they are not to everybody.

While Bokashi is scalable, it is never mentioned that you don't have to start with a 3-5 gallon bin or bucket. It is never suggested that you use rubbish containers and simple (if any) inoculants. There is no profit motive for using the ALT method. The motive is knowledge and awareness in citizen science, at least from my viewpoint. I am not sure if that can be said for all science.

"We might say that the earth has the spirit of growth; that its flesh is the soil."

--- Leonardo daVinci

CHAPTER 13: YOU DECIDE ON PET WASTE

Pet waste is not food waste, which has been my focus. However, many Bokashi sites are also promoting using Bokashi for fermenting pet waste. This makes me a bit apprehensive. I have already found so many myths and a lack of science that I am not sure I totally trust their claims. Ask them for their science and testing relevant to residential use in your location.

The citizen scientist usually lacks sophisticated technology for testing their results. However, you can use common sense. For example, how do you know your fermentation process was successful? You apply the old saying, "If it looks like a duck, quacks like a duck, eats like a duck, and flies like a duck, it is probably a duck." Since most food waste is around a neutral pH prior to fermentation and the goal is to ferment it before it starts rotting or attracting flies, it is easier to apply the "duck test" to it. It smells fermented (not putrid), the pH is about 4.5, and it will keep for weeks without decomposing (rotting). It is also soft and mushy and has partially liquefied. It passes the duck test. Pet waste is more challenging.

Pet waste is foul-smelling to start with and attracts flies. From my understanding, it is also acidic. One of the problems with pet waste is that everybody feeds their pets differently, so there is variability in the waste.

I would first get enough pet waste to fill my container half-full. It should be sturdy enough to withstand some gas pressure and seal tightly. Add water and mix the waste until it is dissolved. Diluting it with water will help adjust the pH (neutral), so add water until it is nearly full. Use your preferred inoculant. I would not incubate it; just keep it in a suitable location where it is consistently warm (not hot).

Since the waste is already in a state of decomposition, I would expect it to continue producing gas initially, contrary to the claims of many of the promoters. I would let it ferment for

longer than food waste without venting. If it is fermented, it should pass the "preserved" test.

Then check the pH to see if it is between 4 and 5. The smell should be different—perhaps not a pleasant "fermented" smell, but not the same smell it had when you started.

There is little you can do to verify the claim that it has killed parasites and pathogens without laboratory testing. If it passed the preservation, pH, and smell tests, it might be safely fermented and safe to bury away from edible plants. Keep in mind that it is acidic and should not be placed in the root zone of established plants as well. I would also bury it deep enough that it is unlikely to be easily disturbed.

Also, consider the volume you are dealing with. The difference between someone who owns a single small dog and someone who owns four big dogs is a matter of scale. Consider how much and how often you need to do the fermentation.

I would not give fermented pet waste away. If you don't have plenty of space to bury your fermented pet waste, giving it to friends, neighbors, and community gardens is no longer an option. What about winter? I use my fermented food waste in my compost pile (which is my preferred method of using it) to keep my pile active. I personally would not use fermented pet waste in my compost.

My guess is that many people will have no qualms about keeping fermenting food waste in their house. That may not be true of pet waste, especially in the winter. So, another consideration will be where you will be doing it.

I have found many of the claims made by "Bokashi experts" to be somewhat exaggerated, and you may want to do some diligent research and small-scale citizen science before attempting pet waste. Learn by reducing your food waste first.

CHAPTER 14: SOIL FOOD WEB

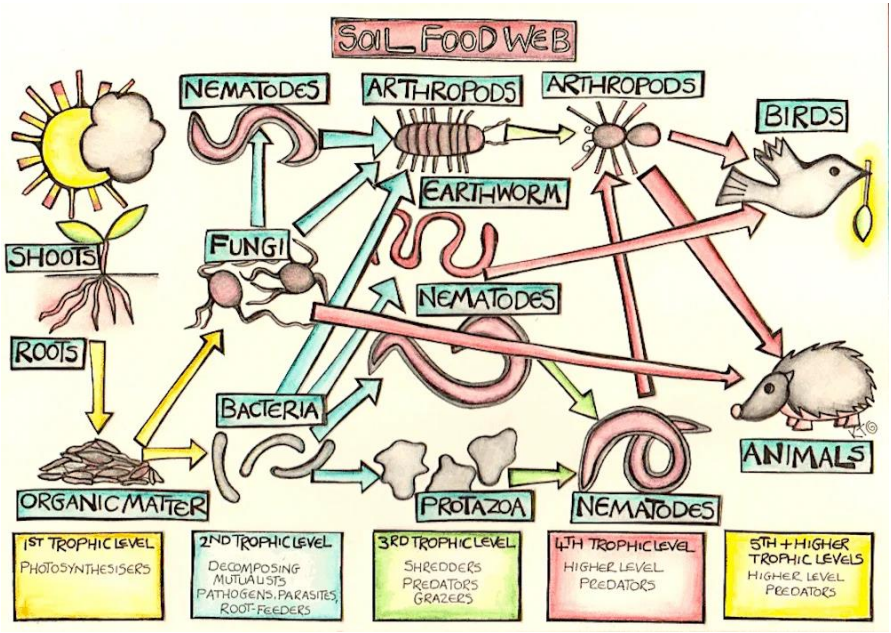

FIGURE 14.1: SOIL FOOD WEB

This depiction of the Soil Food Web (courtesy of https://www.ktshepherdpermaculture.com/) is one of my favorites. There is also a link on her nicely done website to https://www.freepermaculture.com/, which has some free permaculture modules for all levels of learners.

The only thing I would change is to make the arrows two-way since it is a cycle. The plants produce (compose) the food both directly and indirectly for the higher trophic levels, and the waste is then broken down (decomposed), eventually reaching the lowest trophic levels (plants) to make food again.

Fermenting food waste (FFW) essentially allows bypassing the middle trophic levels and returning the organic matter back to the plants more quickly than decomposition while retaining valuable nitrogen and carbon normally lost in the process.

Ideally, it is pulverized (easily with an immersion blender or similar device) since it is soft and "pre-composted." This allows for far faster assimilation by the bacteria in the soil. It happens in a few weeks instead of a month or two. Do the citizen science, and you will find the websites that don't emphasize chopping and pulverizing are misleading you. Another important part of fermentation versus decomposition is the lactic acid. As the lactic acid is converted to lactate in the soil, it becomes a primary energy source for microbes. So, now there are more microbes to make the organic matter available to the plants that rely on the soil food web since the plants need to absorb the nutrients at the molecular level in conjunction with fungi and bacteria.

So, fermentation reduces the time it takes for decomposition to happen and provides a primary source of energy (lactate). This is an advantage over aerobic (with oxygen) decomposition (traditional composting) and why FFW is not compost in the way we use the term. Keep in mind that compost is an essential additive to soil for structure and water retention, but the availability of organic material for the plants to use directly is long-term compared to FFW. So, adding FFW to compost is an ideal combination for making compost even more valuable.

"A cloak of loose, soft material, held to the earth's hard surface by gravity, is all that lies between life and lifelessness."

--- Wallace H. Fuller, Soils of the Desert Southwest, 1975

CHAPTER 15: BRIEF INTRODUCTION TO COMPOSTING

In my opinion, the term “compost” is misused and misunderstood. The origin of the word is “to bring together,” as in "compose." Nature does not compose material. It accumulates them in an unmanaged way. Nature decomposes materials where they accumulate and breaks them down. It is a very slow process, sometimes taking many years. When we compost, we bring together materials in a very specific way called the carbon/nitrogen ratio. We manage this process to minimize the time from years to weeks (my compost typically takes about 12–16 weeks to be ready to use). We also use the term as a noun (the product) and a verb (the process) when it really is a verb. Many people refer to compost as fertilizer, when in fact it is not. The misuse of the term is also prevalent with fermented food waste (FFW), which is often called Bokashi compost or composting, which it is neither.

Most of the introductory content on composting for residential use has four main areas:

- Compost (yard waste)
- Fermented Food Waste (aka Bokashi)
- Vermiculture (using worms, typically with food waste)
- Compost Teas or Extracts (growing microbes)

Compost Tea: When talking about fertilizers, people often look at the NPK (nitrogen, phosphorus, and potassium) values. Aerated compost tea has almost no NPK. It is the microbes you are growing in the tea. These are microbes from previous compost, worm castings, or a commercial inoculant. There is very little organic material in your bucket of tea. Compost tea can be very effective when used on soil with lots of compost or directly on compost, but it is not as effective as FFW.

A common DIY system for making compost tea uses a five-gallon bucket with a couple of air stones supplied with air from a small aquarium pump. While they will produce microbes with

a simple food mixture of oats, molasses, mineral dust, and fish emulsion, it is minimal and almost a waste of time.

By improving the diffuser (which makes the bubbles) and pump (piston instead of a diaphragm), adding some insulation, and most importantly, adding a heater, it dramatically increases the microbial count while keeping the costs reasonable. I also developed a very simple scaled-down version (half gallon), which is great for citizen science testing.

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FIGURE 15.1: LOW-COST, HIGHLY EFFICIENT TEA BREWER

Since using FFW in my compost, I rarely make compost tea anymore. FFW is far less labor-intensive and gives me the same or better results.

Worms: While worm castings (poop) can be an excellent source of NPK, micronutrients, and enzymes, they can also have lots of issues if not properly managed. Much of what people harvest and call “worm castings” is actually

decomposed food and bedding material. In reality, worms are less productive than many “experts” claim. Since their castings are a rich source of microbes, I found the best use for them was to make compost tea. Ironically, as my compost improved, it started looking more like worm castings. Other than the joy of raising them, I no longer need them to consume food waste. I now do that with FFW. While worm castings are a great inoculant for tea, they are impractical as fertilizer.

Compost: Soil analysis can be expensive, so I will give you my subjective opinion using observation, smell, feel, and Pfeiffer Circular Chromatography (PCC) to evaluate compost. Reasonable thermophilic (high) temperatures and longer mesophilic (lower) temperatures during the curing or resting phase will improve NPK and microbial levels in your compost. It is no different than taking more time to make a fine wine.

Commercial compost has to reach very high temperatures to kill microbes and parasites. In the process, it burns off much of the NPK (it is exothermic and produces heat). “Time is money,” and the compost is not given adequate time to mellow and mature. It can be very high in organic material but low in NPK, and it has very little “life” in it.

Instead of 160–180 (F), I target my compost to be 120–130 (F), and because FFW is rapidly assimilated since it is pre-composed, it can spend more time maturing. Fermentation is also endothermic and retains much of the carbon and nitrogen. It increases microbial activity like compost tea, and unlike tea, it is richer in organic matter.

You want compost! It is essential for structure and water retention, but you want rich, mature, biologically active compost. You can make your own or buy commercial compost and improve it by adding FFW weekly over two or three months. You may want to inoculate it with a few shovels of your best garden soil. Experiment!

CHAPTER 16: MEASURING SOIL FERTILITY

While I have seen great improvement in my compost and soil from this time-tested technique of fermenting food waste, it is difficult to measure in a direct way.

While I might get lots of disagreement from soil scientists, I have found the typical soil analysis available to the residential or small farmer does not measure what might be termed "life forces."

In my studies and volunteer work at the Citizen Science level, I was introduced to a biodynamic technique developed by Ehrenfried Pfeiffer called circular chromatography, also referred to as Pfeiffer Circular Chromatography (PCC).

It is not difficult to do, and while the results are not "hard" science, they are very useful and quite beautiful. The analysis of them is very subjective and can only be learned by doing hundreds of them on many different soil or compost samples to see their value. They are also very difficult to standardize.

Just by following simple instructions and using very simple equipment, anyone can produce a "chromatogram," but reproducibility from person to person is not very good. They can be useful if there is consistency in the equipment and technique.

To solve this problem of reproducibility (called precision in science), I have developed an Avery Low Tech (ALT) method for doing Pfeiffer Circular Chromatography (PCC). So, I and others doing citizen science, or even more rigorous science, can use PCC as a tool.

Potential users might be others doing composting methods, regenerative growing techniques, biochar, permaculture, and compost teas. They are concerned with microbial fertility and "life forces" in the soil and compost and want to try the ALT Method for PCC.

The ALT method has been very useful in testing composting techniques using worm casting tea and now fermented food waste to improve my compost.

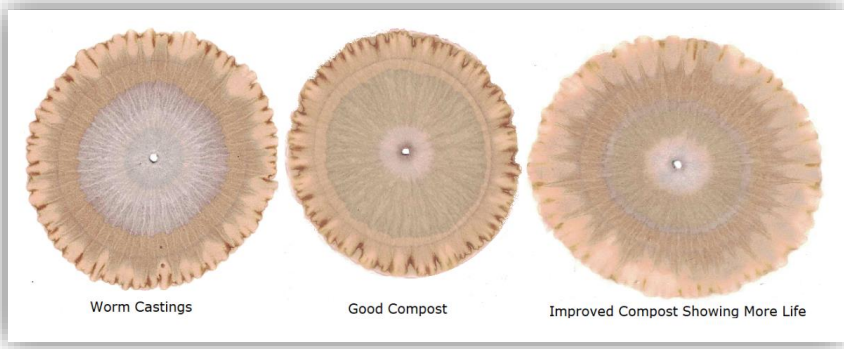


FIGURE 16.1: THREE CHROMATOGRAMS SHOWING COMPOST IMPROVEMENT

Figure 16.1 shows a PCC of worm castings that are rich in "life" (microbes and enzymes) on the left. In the middle is good-quality compost made using traditional methods, and on the right is compost made using aerated worm casting tea instead of water. This is evidence that the compost improved and the chromatogram moved in the direction of the worm castings. However, the soil analysis was almost identical between the two batches of compost.

This shows the use of PCC as a qualitative tool for determining the results of a trial. From that point on, all our compost was made using worm casting tea.

This was possible because the chromatograms were done with standardized equipment and uniform techniques. Had they been done by different people using different equipment, they would not have been as useful.

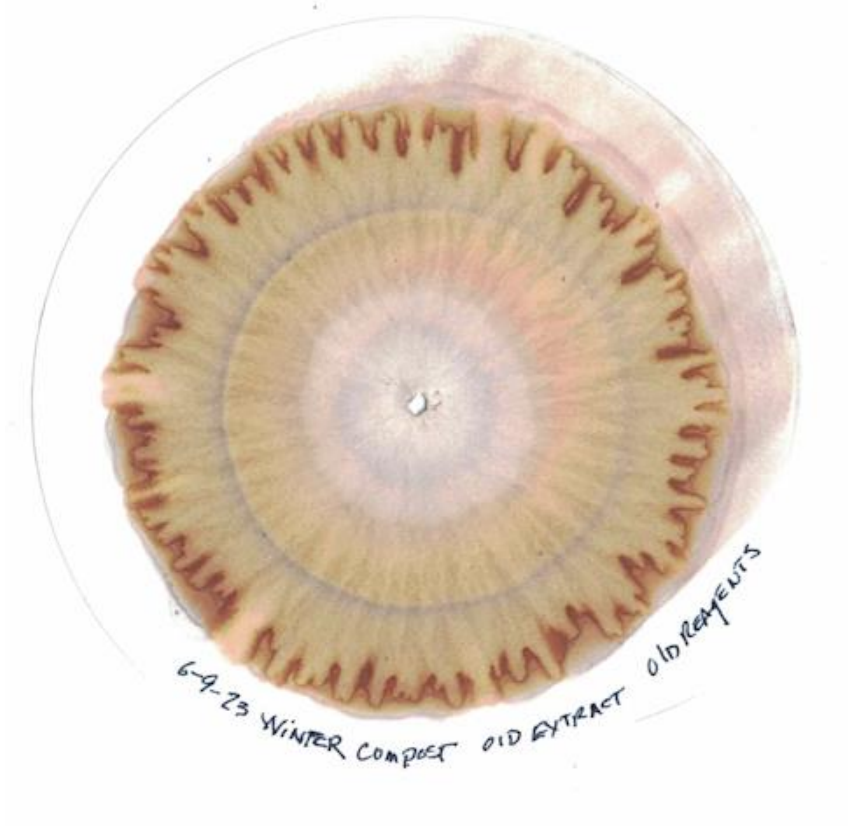


FIGURE 16.2: WINTER COMPOST USING FFW

Figure 16.2 is compost that was done with FFW instead of worm casting tea over winter 2022. We had some very extreme cold temperatures and our normal four feet of snow. The pile stayed active all winter, which indicates very active microbes. Compare it to the chromatograms in Figure 16.1, and it comes closer to worm castings, so much so that it changed the way I do my composting.

I chose this chromatogram because it shows how good this batch of compost is and how forgiving PCC can be. This was done with reagents that are three years old. Normally, the chromatogram is done within several hours of the extraction. This was done after two weeks. I also hung this one to dry after treating it with vinegar rather than letting it dry lying flat on a paper towel. This is what caused the "bleeding." In spite of those deviations from the instructions, it produced a very usable chromatogram. This chromatogram shows that using FFW in my compost not only kept it active all winter, but it also shows far more microbial activity than I was getting with aerated worm casting tea. It is far less labor-intensive to make FFW using the ALT Method, and it provides a consistent way to use the ferment all year, even in winter.

The bottom line is that the claims from the Bokashi experts about the benefits of FFW are true. It is their techniques and equipment that are not applicable to most of us. By doing some simple citizen science, they may want to make their claims more realistic for the billions of people who don't know about Bokashi, let alone try it.

Just as fermenting food waste has the potential for some community involvement, PCC can be done as a community project. Groups of small farmers, neighbors, or community gardens could dramatically reduce the costs per chromatogram by joining together. Although the costs are already lower than for many soil testing services.

If you have an interest in PCC, you can find more in the Resources chapter and the Supplemental Chapter on PCC.

"To forget how to dig the earth and to tend the soil is to forget ourselves."

— Mohandas K. Gandhi

CHAPTER 17: CLOSING THOUGHTS

When I tried Bokashi using the DIY bucket, I learned that it was messy, smelly, and did not perform the way the "experts" were telling me. Like many others in the same situation, the bucket just faded into non-use and still sits in the garage, awaiting a new, repurposed life.

It is quite a different story, as I worked on the ALT method for fermenting food waste. I have learned a great deal, and it has been an evolutionary process. I now realize that it is as useful as a learning tool (citizen science).

One of many lessons I learned was not all waste gave me the same results. Excessive amounts of coffee grounds seemed to affect the process and made it very messy. Now we save our coffee grounds and use them directly in the compost pile or as a top dressing on our acid loving plants.

Another lesson I learned was that there are many ways to accomplish the same goal. I am not a cook, at least not the type that requires an immersion blender. It was in some discussions about the advantages of pulverizing the ferment that someone asked me about immersion blenders. It greatly simplified the pulverizing of the FFW. Now that my primary containers are milk cartons, I can “blend” the FFW directly while in the container.

What I find is that I enjoy doing citizen science. I learn many lessons along the way and find I am far better at explaining things to others as my knowledge grows. This is something any good teacher will tell you: we learn as we are teaching, and that is one of the big joys of teaching. It is a humbling experience.

As I do more talks and presentations about fermenting food waste, I get the same two questions popping up.

- Is it absolutely necessary to blend or super-chop the waste?
- What can I do with the ferment if I don't have a garden or compost pile?

Now that you know more about the topic, let me reemphasize my responses to those questions based on my experience.

	Expensive Bin	DIY Bin	ALT Method #1	ALT Method #2	ALT Method #3
Capacity	3-5 gallons	5 gallons	Scaleable	Scaleable	Scaleable
Waste Size	Unchopped	Unchopped	Chopped	Chopped	Super Chopped
Fermenting Time	14-21 days	14-21 days	5-7 days	5-7 days	5-7 days
Incubation	None	None	Optional	Optional	Optional
Post Fermenting	None	None	None	Blended	None
Assimilation Time	3-4 weeks	3-4 weeks	2-3 weeks	2 weeks	2-3 weeks
Ability to Store	None	None	Yes -in container	Yes-in container	Yes-in container
Ability to Give Away	None	None	Yes -in container	Yes-in container	Yes-in container
Clean up	Messy	Messy	Minimal or None	Minimal or None	Minimal or None

FIGURE 17.1: TYPICAL SCENARIOS FOR FFW

All the methods produce fermented food waste. So, what determines the best method is what works best for you.

We determined that we normally generate about ½ gallon of chopped food waste per week. We wanted short assimilation times in our compost pile. We needed to store ferment until the compost pile needed turning, and we wanted to do this all year. So, ALT Method #2 fits our needs the best. It is ideal for us, but it may not be for everyone.

If chopping and blending seem to be things people don't want to do, then don't chop or blend. However, expect longer fermentation and assimilation times.

When the Bokashi sites tell you to bury your ferment before planting your garden, they are giving you a very limited way to deal with food waste on a year-round basis. If you don't have a moderate-sized compost pile or even a garden, you will need to find alternatives for your FFW.

In my city, you can get a "green bin," but they charge extra for it and don't collect it all year. This is where you will need to do some research before generating ferment.

- Share a green bin with your neighbors.
- Find neighbors or local farms that compost and will take your ferment.
- Get your apartment manager or HOA to get a green bin specifically for fermented food waste.
- Some markets and food vendors contract with companies that buy their food waste.
- Work with your municipal leaders and Conservation Districts to "brainstorm" solutions.

Many communities are working on practical solutions to solve food waste issues, so get involved with like-minded people.

So, my conclusion is that there is no conclusion. Everyone who ferments food waste has different resources. The ALT Method is both a learning tool and an environmental tool. It is essentially free when using repurposed rubbish containers, and if we all do a little, it is more impactful than only a few. The biggest challenge will be challenging others to join in being the drops that make an ocean. Little changes can make big differences!

THE FUTURE OF THE ALT METHOD

Every time I think I have made this process as simple as possible, I find a way to simplify it. Much of this happens when I question people about why they don't do FFW and, in particular, the ALT Method. Their answer is usually a rationalization. If I find a way to eliminate their rationalization,

it brings them one step closer to being a drop in the ocean. I adhere to the philosophy that a hypothesis can't be proven true, but it can be refuted. An unrefuted hypothesis can then lead to more predictions.

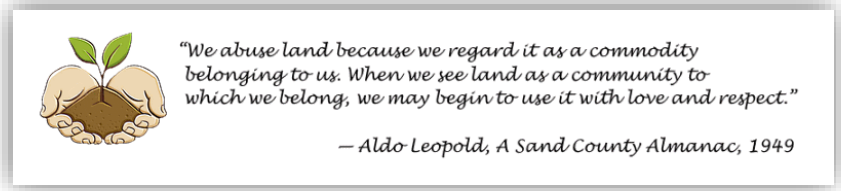
> *Hint: Read the philosophy of Karl Popper*.

While the amount of food waste any of us can reduce is tiny compared to the scope of the problem, think of the multitude of drops. There is little that keeps the ALT Method for FFW from being universally done on a global scale, except rationalization. Sure, there are exceptions, but those are not rationalizations; they are exceptions.

My wife and I average about ½ gallon of actual waste each week, which is about two pounds. If we round down to 8,000,000,000 people on Earth and ten percent of them did two pounds per month (a milk carton's worth), a small commitment, that would generate 9,600,000 tons per year of waste removed from the waste stream.

> 800,000,000 (10% of people) x 2 (pounds) x 12 (months in a year) divided by 2000 (pounds in a US ton) = 9,600,000 tons

Of course, that is an idealistic proposition. The point is that if many of us did a little, we collectively could have a huge impact on the big problems facing us. Right now, only a small number of people use the ALT method for FFW. If you do it and find it satisfying to be a part of a solution, then please share it.



CHAPTER 18: RESOURCES

At the time this was published, these resources were available. The supporting website for this book will have updates if they change.

DOCUMENTS AND VIDEOS FOR FFW AND PCC

One reason for keeping a website is for feedback. Much of the progress I have made in simplifying the method has come from questions. Any self-respecting teacher will tell you that good, sincere, and challenging questions are a major rush for a teacher.

There is a contact form on the site, as well as direct links to a free copy of this book (PDF), templates for the Milk Carton Challenge, videos and supporting files for Pfeiffer Chromatography.

https://sites.google.com/view/averylowtech

(Contact page and direct links)

The PDF files and supplemental videos for this book can be viewed, downloaded, and listened to by anyone. The best way to find these files if you are not following a direct link is to search “Bokashi Alternatives." The supplemental files are stored in the Archive separately from the book, as are the video collections. So, if the Avery Low Tech website is not available, you can access the files in the Archive.

ABOUT YOUTUBE VIDEOS

Since I have many other interests (Monarch butterflies, Tardigrades, compost tea, etc.), I have videos for them as well. My focus is encouraging citizen science. So, in spite of the control Google forces on us with their search engine, I maintain a YouTube channel. I don't monetize anything on the channel and will remove or alter any videos that get popular enough to have ads associated with them.

Videos for the ALT methods of fermenting food waste and Pfeiffer chromatography will have a primary location on the Internet Archive, but they might also be found on YouTube. They will always be low-tech and unenhanced. You can also search YouTube using my channel identifier, @kennethavery2405.

RECOMMENDED READING

First on my reading list is anything written by James Lovelock, especially The Practical Guide to Planetary Medicine. When he postulated the Gaia hypothesis, he was ridiculed by the scientific community but is now considered vindicated. It was reading Lovelock's autobiography that accelerated my interest in low-tech and my passion for the biological sciences. We are now finding that even physical systems are influenced by the trillions of species of microbes on our planet, just as our health is related to our gut microbes.

Next is "*Small is Beautiful"* by E. F. Schumacher. As an economist, he came to realize the importance of appropriate technology that benefits us now without sacrificing the future. My Peace Corps experience in Tanzania confirmed the need for low-tech. His writings are considered to be among the 100 most influential since WWII. Schumacher College in England offers holistic ecology-centered and horticultural degree programs and was created in his honor. The first guest teacher was James Lovelock.

If you are interested in PCC the definitive book is *Chromatography Applied to Quality Testing, Ehrenfried Pfeiffer*, ISBN-10: 0938250213. It might still be available as an eBook in English.

RECOMMENDED COLORING (FOR ALL AGES)

If you are not familiar with the importance of soil microbes, the United States Department of Agriculture has a **free** downloadable coloring book for children titled *Mighty Mini Microbe's Tale*. It is a great introductory book on being a soil health farmer of any age.

FIGURE 18.1: MIGHTY MINI MICROBES TALE

https://nrcspad.sc.egov.usda.gov/distributioncenter/pdf.aspx?productID=1429

CHAPTER 19: AUTHOR AND TECHNICAL ADVISOR

FIGURE 19.1: KEN AVERY AND ANN JACKSON-AVERY

There is no way I can acknowledge all the people who contributed to the development of the ALT methods.

I am constantly amazed at the unintended consequences of people and situations that end up shaping our lives.

I have been on this path since hanging out in Grandpa's shop with very influential teachers who nurtured my interest in science. There was the squadron desk clerk who assigned random names to a list of work details that had me vacuuming a state-of-the-art computer lab while in tech school in the USAF. It started me down a path that allowed me to teach Information Systems for 27 years at a local community college.

While doing volunteer work at a local state prison as a sustainability volunteer on a vermiculture project and seeing a large-scale Bokashi project, it led me to join a Master Composter program. It was in that program that I met a passionate young biodynamics enthusiast who led me to Pfeiffer Circular Chromatography and compost teas (thanks, Ryan).

While I have always been interested in microbes, it was a kind and gentle mentor who shared her love of microbiology (thanks, Rita). That led to working many years later in a large teaching hospital microbiology lab, where I met Ann, who not only tolerated my eccentricities but added to them.

Ann is a retired professional horticulturist, among other things. She has been a vital part of my support and guidance for my ideas and choices. As a married couple, we went to Tanzania in the Peace Corps, which influenced my interest in low-tech.

What a perfect blend for dealing with FFW, a horticulturalist, and a microbiologist, and that doesn't even include all the other things: simplicity, spirituality, a love of nature, and much, much more.

I have sprinkled tidbits in the book about enough of my qualifications to call myself a peer among those promoting FFW. My science background and life experiences have given me the confidence to share my ALT methods. If nobody chooses to try them except us, Ann and I can say we tried.

We hope everyone can say that.

It takes some S-W-E-A-T to transform W-A-S-T-E

Ann Jackson-Avery, 2023

SUPPLEMENTAL CHAPTER ON PFEIFFER CIRCULAR CHROMATOGRAPHY (PCC)

Again, let me emphasize that this chapter will not be applicable to most individuals who ferment their food waste. It is a useful tool for evaluating soil fertility for those who want to evaluate the use of soil or compost supplements.

Combined with a typical soil analysis, the use of PCC could be useful for evaluating FFW, biochar, compost teas, and regenerative growing techniques. It is inexpensive to do without sophisticated laboratory equipment or extensive laboratory experience. It is well within the realm of school use, and in particular, Waldorf schools. It has been widely used in the wine industry.

The ALT method simplifies the technique Pfeiffer used in the laboratory by standardizing the equipment to readily available equipment used worldwide. In doing several hundred chromatograms over the years, the ALT Method for PCC has given very acceptable results for a qualitative technique that can be done on the kitchen table.

There are some very low-tech videos listed in the Resources chapter.

LIST OF SUGGESTED EQUIPMENT

Keep in mind that this is suggested equipment. If you choose to use other equipment, it will be difficult to directly compare your chromatograms with those of someone else using different equipment.

All of this was available at Amazon, but it is also readily available from science and medical supply outlets. It is not possible to give you a specific list since sellers on Amazon change frequently.

A good business opportunity would be for someone to bulk buy everything and sell kits and components.

FIGURE S.1: SUGGESTED EQUIPMENT (CLOCKWISE FROM RIGHT)

1. Whatman Grade 1–15 cm Filter Paper
2. The small teaspoons (drop-1/64 teaspoon, pinch-1/16 teaspoon, and smidgen-1/32 teaspoon)
3. Micro-scoops (blue) Liftmode Large 8–10 mg
4. 50 ml flat-bottom centrifuge tubes (sample extraction).
5. 15 ml plastic centrifuge tubes (silver nitrate preparation)
6. 90-mm plastic petri dishes (bottoms will be used.)
7. 35-mm plastic petri dishes (bottoms will be used.)
8. 3 ml disposable pipettes
9. Sodium hydroxide (analytical grade or high-quality food grade is acceptable as fine crystals)
10. Silver nitrate (use ASC grade when possible)
11. Templates: Downloadable (Resources chapter)

12. The remaining items: a timer, a plastic tub, teaspoons and tablespoons, nails (1½ and 3 inches), forceps, a large plastic lid with a hole in it, a small sieve or strainer, and a test tube rack, are easily found around the home or in a local store.

HELPFUL TIPS

FIGURE S.2: HUMIDITY CHAMBER

If you live in an area with low humidity (below 50%) you will need to provide additional humidity during the final phase of the procedure. This is done by using damp paper towels and some type of tub or cover to retain the moisture. This small tub is transparent and can cover two samples. If you live in an area or are in a controlled environment where the humidity is above 50%, you may not need to use covers.

The symptom of low humidity is that the chromatogram will not reach the second dot on the filter paper (no matter how long you leave it sitting on the extraction liquid). If this happens and you have prepared spare filters with silver nitrate, you can repeat the final step since you have the remaining extract (this time with a cover).

FIGURE S.3: FILTER PAPER SUPPORT

To make it easier to insert and remove wicks, use a plastic container lid with a hole drilled in the middle that is larger than a rolled wick. Insert the wicks from the top down and remove them from the bottom (forceps will help). Try to avoid tearing the filter paper when inserting or removing wicks. The most critical time is removing the wet wick after the silver nitrate step.

FIGURE S.4: KEEPING THE TUBES FROM GOING ASTRAY

Use the bottom of a tissue box (with the corners taped) to keep the tubes rolling in a straight line. You don't want to shake the tubes; it will introduce air into the solution. You want to mix, but not aerate.

FIGURE S.5: USE AN EGG CARTON AS A TUBE RACK FOR THE EXTRACTION TUBES

Get creative with things you can repurpose.

MAKING THE WICKS AND PREPARING THE FILTER PAPERS

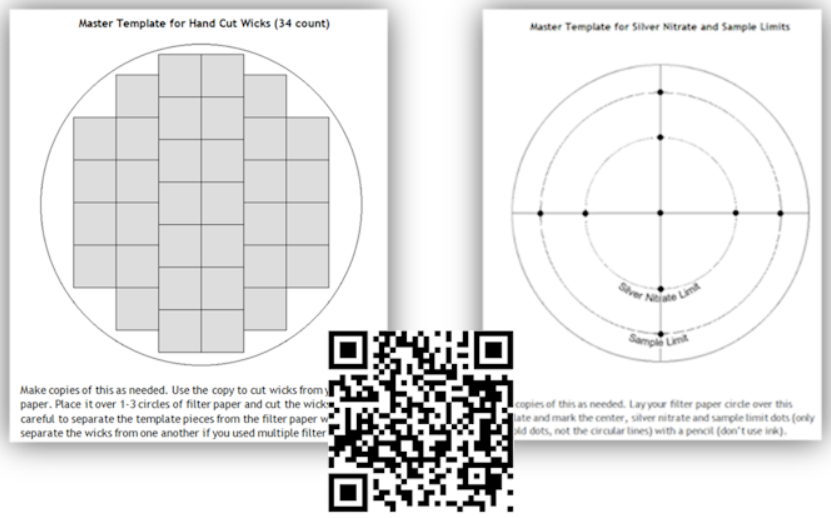


FIGURE S.6: DOWNLOADABLE TEMPLATES FOR MAKING THE WICKS AND MARKING THE FILTER PAPERS (RESOURCES CHAPTER)

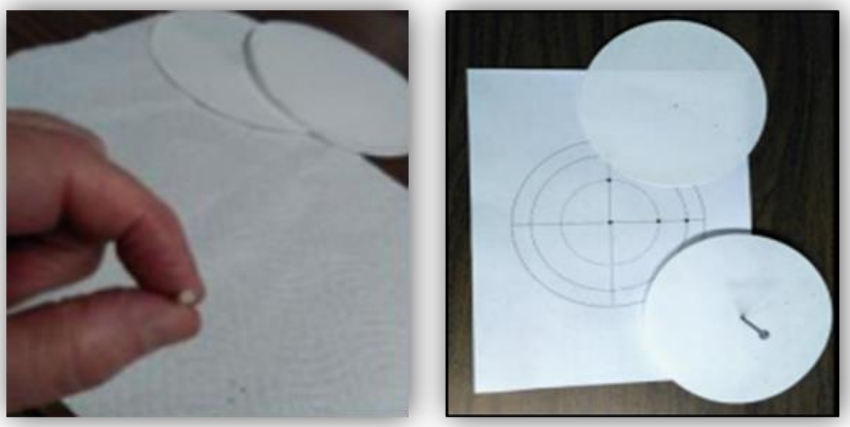


FIGURE S.7: CUT AND ROLL WICKS TIGHTLY (SOME THIN WIRE MIGHT HELP) AND MARK THE LIMIT DOTS AND WICK HOLES FOR YOUR FILTER PAPERS.

You can store extra wicks in a dry container until needed. After marking the limit dots on your filter papers, use a downward motion to punch a clean hole for the wick at the center dot with a three (3)-inch smooth-shank common nail.

PREPARE THE SAMPLES.

While the Pfeiffer method is used for many things, including foods, juices, extracts, seeds, and more, the main focus of the ALT method is soil and compost. Consult the Pfeiffer book for other materials.

Compost: It is important to have a homogeneous sample of your entire pile, so it is best to mix the pile to get uniformity before taking your sample. If your sample is wet, allow it to dry in indirect light until it is dry enough to pre-screen without plugging the screen. Use ¼ inch hardware cloth or equivalent to pre-screen everything you can get through the screen, breaking all the clumps that you can. Do not over-dry it.

Soil: Collect your sample from the root zone and avoid surface material. If it is overly wet, then dry it in indirect light until it can be pre-screened without plugging the screen. Break up any clumps as you pre-screen it. Do not over-dry it.

In general, most soils and compost will work well with the ALT Method; it is those extreme cases or unusual materials like biodynamic preps, heavy clays, sand, or materials lacking in active organic material that will need adjustments to the technique.

FIGURE S.8: USE A SIMPLE KITCHEN SIEVE TO GET A UNIFORM PARTICLE SIZE

Set small sub-samples of the pre-screened partially dry material aside in indirect light (several tablespoons each) to dry more if needed until they do not plug the screen when "mortared" with the back of the measuring spoon. *Do not use a real mortar and pestle.* If the fine mesh screen plugs easily, your sample may still be too wet.

To minimize the time difference between samples being mixed with the sodium hydroxide solution (NaOH) in the extraction step, it is best to pre-measure the sample. Label a 15-ml tube and add one-half tablespoon of lightly packed sample to it; you may need to use a funnel. Get all your samples ready before beginning the procedure.

When the samples are ready, prepare your extraction tubes prior to starting. Label a 50-ml tube for each sample and add one level "pinch" (ancient term for 1/16 teaspoon) of NaOH (carefully, it is caustic) and cap it. Both the samples and extraction tubes can be prepared a few days before the actual procedure.

INSTRUCTIONS (READ COMPLETELY BEFORE STARTING)

Have a cup of distilled water ready, an empty cup or tube rack to keep the tubes upright, a kitchen timer (or phone app), and some forceps or tweezers (one only). You may also need a transparent storage container large enough to cover the paper disk (like you would store food in). It is best to read the Helpful Hints before starting.

THE EXTRACTION

Add 45 ml of distilled water to each extraction tube and put the caps back on. You may need to use a dropper to avoid overfilling as you get close to the 45-ml mark (avoid contaminating the dropper). Gently invert the tubes several times to dissolve all the NaOH.

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FIGURE S.9: ADDING THE SAMPLES TO THE NAOH AND ROLLING

Place the tubes in a rack and remove the caps. Carefully add the sample to the matching tube. Cap the tubes tightly and lay them on their sides (use a shallow box to prevent them from going astray).

- Roll for two (2) minutes.
- Place in the rack for fifteen (15) minutes.
- Roll for two (2) minutes.
- Place in the rack for forty-five (45) minutes.
- Roll for two minutes.
- Place in the rack for a minimum of five (5) hours.

Do not disturb the samples during or after the settling period. They can go overnight if necessary and will remain suitable for days if refrigerated (although I would avoid it unless there is an absolute need).

PREPARING THE FILTER PAPERS AND SILVER NITRATE

It will take 3-5 hours to prepare the filter papers (most of it is absorption and drying time). It is usually done during the five hour settling period.

The silver nitrate is prepared in 5-ml units. Each 5 mL will make two papers. So, if you intend to do two samples, you will only need 5 ml, four samples will need 10 ml, and six samples will need 15 ml. Use caution with the silver nitrate and read the precautions on the label.

FIGURE S.10: USING THE MICRO-SCOOP TO MAKE THE SILVER NITRATE

Using a 15-ml tube, place one micro-scoop of silver nitrate for every 5 ml you are making. The scoops do not need to be level scoops, and they also don't need to be heaped as high as they can go. I find that after getting a scoop, a gentle tap against the side of the bottle gives me the correct amount.

If you were to err on this step, err in getting slightly too much rather than two little. The silver nitrate determines how light or dark the chromatograms are, and it takes a considerable amount more than the micro-scoop can hold to affect the results. If your chromatograms seem to consistently be light, use a slightly larger heaping on the scoop. If your chromatogram seems too dark, you are being too generous. But stay calm; this step is not as critical as you may think.

Once you have measured the proper amount, carefully add the corresponding 5, 10, or 15 ml of distilled water according to the graduations on the tube (use your water pipette and avoid contaminating it). Put the cap on tightly and gently mix. If it is cloudy, your silver nitrate needs to be replaced or the tube is contaminated.

Label a filter paper on the outside margin with an identifier to match each sample and insert a wick in each one.

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FIGURE S.11: INSERT A TIGHTLY ROLLED WICK FROM THE TOP INTO EACH FILTER PAPER

FIGURE S.12: ADDING AGNO3 TO THE 35MM DISH

Pour the contents into the 35-mm silver nitrate (AgNO3) dish sitting in the center of a 90-mm extraction dish, or use the AgNO3 pipette to fill it about two-thirds of the way. (Do not use this pipette for anything else.) You can add a little more after the first paper is done to bring it back up to two-thirds.

Pick up a filter paper by the wick (make sure your hands are dry) and place it with the wick in the center of the 35mm dish, label side up. Make sure the wick is touching the bottom.

FIGURE S.13: PLACE THE WICK INTO THE SOLUTION UNTIL REACHING THE FIRST LIMIT DOT

When the expanding silver nitrate liquid reaches the first mark on the paper, remove it (holding the disk by the edge) and gently pull the wick straight out from the bottom (read the helpful hints about using a plastic lid to make it easier). If the wet area is not perfectly circular, that is normal; the first dot it reaches is when it is done.

FIGURE S.14: AIR DRYING OUT IN BRIGHT LIGHT

Dispose of the wick and place the wet filter paper on a 90-mm drying dish out of direct light but where air can circulate around it to dry.

Make sure the prepared AgNO3 papers are dry; if not, do not proceed until they are dry and the minimum five-hour settling period is done.

FORMING THE CHROMATOGRAM

Lightly moisten a paper towel and place the 90-mm extraction dishes on it far enough apart that the filter papers will not touch each other. Place an unused 35-mm sample dish in the center of each 90-mm dish. Add tightly rolled wicks to the now dry AgNO3 filter papers, gently inserting the wicks from the labeled side (top).

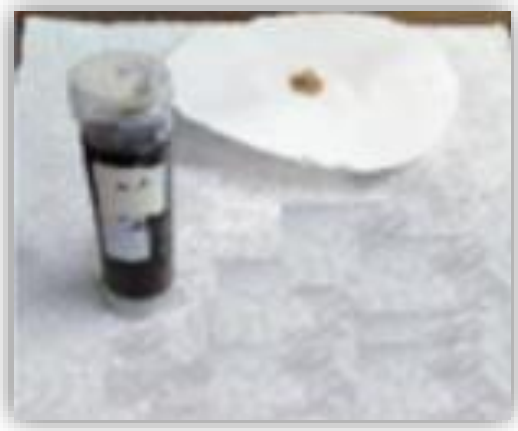

FIGURE S.15: FILL EACH 35-MM DISH TWO-THIRDS FULL USING A PIPETTE.

Do not pour the extract; it will disturb the sediment. Use a pipette to fill the 35-mm dish two-thirds full (do not aspirate any sediment). Make sure you have the correct filter paper for the sample and place it in the dish with the wick in the center touching the bottom of the dish.

If you are working in an area with low humidity (below 50–60%), it is difficult for the filter paper to wick enough liquid to complete the final step. Cover them with a transparent storage container to protect them from drafts and provide humidity. **Note: They need humidity. In high-humidity areas, it may not be necessary to cover them. Read about the symptoms and possible recovery in Helpful Tips.**

FIGURE S-16: "HUMIDITY CHAMBER"

Be Patient! It might take 45 minutes or more to get the expanding liquid to reach the second mark. When it does, remove the wick and place the paper back on a support dish to dry (do not cover). They may each take different times since they are different materials.

In every batch of chromatograms I do, I use a "known" sample. This is what is called a "control." If the known sample does not appear as it should, it would indicate a problem.

Use a container to combine all the remaining silver nitrate and sodium hydroxide solutions together. This will neutralize them and make them safe for disposal down the drain. Any equipment that came into contact with the silver nitrate or sodium hydroxide should not be reused for future PCC; the technique is very sensitive to contamination. They can be washed and repurposed, recycled (if acceptable), or discarded. Tubes or dishes that did not contact those reagents can be reused.

When they are dry, tape or hang them in a window that does not get direct sunlight for a day or two to fully develop (use the tape sparingly so they are easy to remove).

FIGURE S.17: EXPOSE THEM FOR A FEW DAYS.

Optional: You can lay them in a dish of distilled vinegar after they are fully developed in a few days until they are fully soaked (it just takes a few seconds), and then dry them lying flat on a paper towel to prevent "bleeding." This will prevent them from discoloring when exposed to light in the future.

Label each disk with dates and other details on the outer portion in pencil and store them in the plastic bags. Avoid over-handling them and showing them in direct sunlight. It is that easy.

To create a backup, it is advisable to scan your chromatograms. To prevent them from becoming soiled from handling the chromatograms, they can also be laminated.

EVALUATING CHROMATOGRAMS

One of the reasons PCC is not considered "real" science is that it is difficult to interpret. The best solution to this is not to read too much into them until you have done many of them; let the chromatograms be your teacher.

When I first started, I built a library of "known" soil types so I could see how the chromatogram changed as the soil type changed.

FIGURE S.18: TRANSITIONAL SOILS (BEST ON LEFT)

As I tested soils on our property, I observed a transition from the poor, sandy native soil on the right to worm castings from my worm bin on the left. Over time I used my experience and research to create a basic evaluation key.

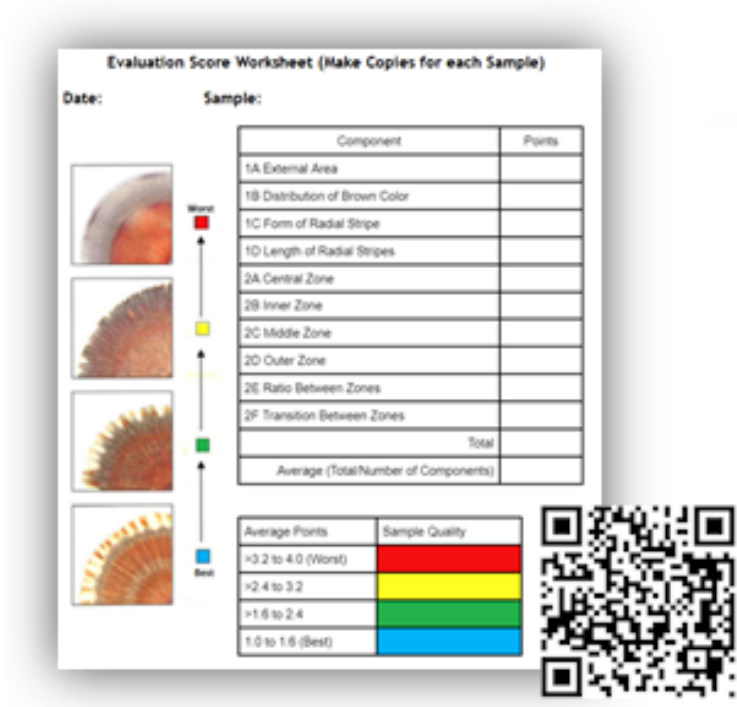

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FIGURE S.19: THUMBNAIL OF THE DOWNLOADABLE EVALUATION KEY

The free Evaluation Key helps you evaluate ten characteristics of a chromatogram and assigns a score to each one. Since one of the goals of the ALT Method for PCC is to standardize the technique, it allows the Evaluation Key to be used on samples done by others and somewhat standardize the results.

The Key works best when viewed in a larger format. The several-page key is downloadable (8.5x11) as a PDF file. The link is in the Resources chapter or uses the QR code.

If you are using worm castings, good-quality soil, or compost as a control, you can also use that as a reference. You just need to see if the sample is moving toward the control in appearance compared to previous testing.

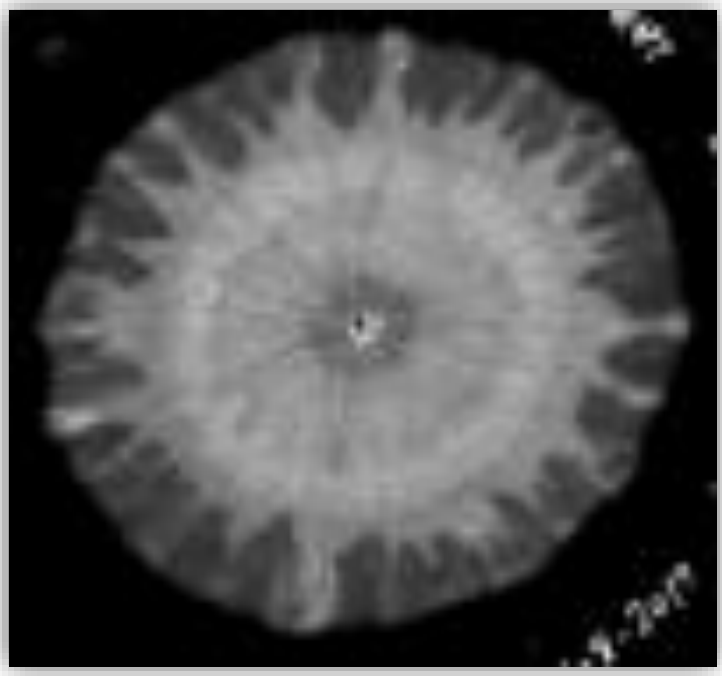


FIGURE S.20: X-RAY VISION AIDS IN EVALUATIONS

Use X-Ray Vision: Paint.net is an open-source program that has many useful features. There are many other graphics applications that have similar features. You can open a scan of your chromatogram and convert it to black-and-white, invert the colors, and adjust the brightness and contrast to make it look like an x-ray. I have found it helps me see some of the fine detail, especially the radial lines, when I am "keying" them.

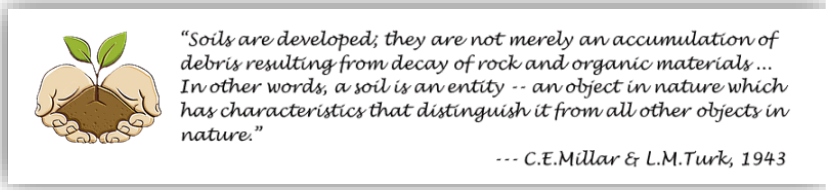


TABLE OF FIGURES (BY CHAPTER)

DISCLAIMER

People have fermented food waste for hundreds of years and have done thousands of chromatograms without incident. However, you are handling food waste, sharp instruments, and chemicals that have possible risks. You should always treat all reagents, soil, compost, and food waste with care, regardless of their potential toxicity or not. Use proper handwashing and common sense. While I encourage children to become involved in their future, it should be done with adult supervision and guidance.

It is not possible for me to test every type of waste or every type of container under every circumstance. As a “citizen scientist” I am not using standard laboratory equipment or standards. Like any scientist you publish your observations and results for others to verify or refute.

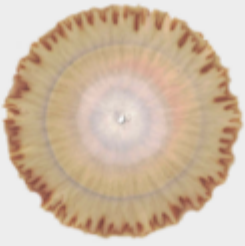
There is a Contact page on the website, and I will try to respond to questions and comments, but this is not a business; it is a passion.

While none of these techniques are patented, it is my hope that if someone uses them for a business, it is done in the spirit of helping the earth rather than digging us deeper into the hole.

I also want those selling Bokashi materials to realize that I don’t think anyone is deliberately cheating or being dishonest. I do think many of them need to be as much scientists as they are business people.

So, the bottom line is that there are no guarantees or liabilities on my part. Be safe, care, share, and be part of the solution.

Everyone can repurpose milk cartons and other rubbish for fermenting food waste into a soil additive, which is simple and can be done for free. It is Bokashi simplified using the ALT (Avery Low Tech) Method of Fermenting Food Waste and features the Milk Carton Challenge. It also includes a Supplemental Chapter on Pfeiffer Circular Chromatography (PCC), a simple technique for measuring the "life" in your soil or compost.



A PCC of compost that stayed active all winter (E. WA) and was full of life and ready to use in the spring.

1/2 GAL (1.89 L)

USDA ORGANIC

1-1-2024